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# PHILOSOPHICAL JOURNAL,

EXHIBITING A VIEW OF THE
PROGRESSIVE DISCOVERIES AND IMPROVEMENTS
IN THE
SCIENCES AND THE ARTS.

CONDUCTED BY

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ERRATA.

P. 292. Note, for *Potychlorus*, read *Polychlorus*.

# THE

# EDINBURGH NEW PHILOSOPHICAL JOURNAL.

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## *Biographical Memoir of* Baron de Beauvois.[*] *By* Baron Cuvier.

Ambroise Marie François Joseph Palisot, Baron de Beauvois, Member of the Academy of Sciences, of the Royal Institute of France, and of several other learned societies, is among the number of those whose life proves to what extent the assiduous study of nature is a more certain source of individual happiness; how many more probable chances it affords of being useful to the public; and how, when it leads to misfortunes, it affords more resources to sustain one under them, than that stormy career of business in which it is rare to see men so energetic, or so favoured by fortune, as not to become the sport of events, or never to have to reproach themselves with conduct of a censurable nature. A learned botanist, a fortunate collector, an author of approved works, he acquired without difficulty a lasting name in the sciences; the fatigues to which he exposed himself in procuring some additions to the treasures of natural history, never altered the peace of his mind. On the other hand, as a magistrate, and a member of political assemblies, he was, on the contrary, overwhelmed with persecutions and sufferings, which must often have appeared so much the more painful to him, that they did not always leave him the consolation of being able to say that his prejudices and errors, or at least those of the party which he embraced, had not contributed to them.

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[*] Read to the Royal Academy of Sciences on the 27th March 1820.—This Memoir will be found interesting to those who take a part in the discussions in regard to the Slave Trade, and the moral condition of the Negro race.

He was born at Arras, on the 28th October 1755, of an old family, which, for two centuries, had occupied considerable offices in Artois, and had given four first presidents to the superior council of that province. His father, after being some time a member of that court, was compelled, by the decay of his fortune, to exercise the office of receiver-general of the domains and woods in the territories of Picardy, Flanders, and Artois, which had been in his family from 1685. Our academician, after serving a short time in the infantry, destined himself for the law, and had procured the office of advocate to the king at Chatelet, when he saw himself obliged to change his projects, by the death of his elder brother, which happened soon after that of his father, and which left him the office of which we have just spoken.

This office, although lucrative, required but little exertion for the discharge of its duties, and the young receiver-general had too much activity not to desire some means of occupying his leisure hours. These he found in the lectures of M. Lestiboudois, professor of natural history at Lille, a learned and respected naturalist, who had the talent of inspiring his hearers with a taste for science. He cultivated with so much care and attention the dispositions of his new pupil, that they presently assumed the character of a real passion. Alone, or with his master, M. de Beauvois continued to collect plants and insects. He had already in a manner exhausted his province, when, in 1777, an edict of the king, elicited by M. Necker, suppressed the offices of receivers-general of the domains, and reducing him entirely to a private life, afforded him an opportunity of seeking more abundant sources of instruction.

He went to reside at Paris, and there assiduously attended M. de Jussieu's botanical excursions. In a short time he was ranked among those men in whom botany might place her hopes. In 1782, the Academy named him a correspondent, and in 1783 and 1786, his friends brought him forward as a candidate for the places which Duhamel and Guettart had left vacant.

It was at this period, also, that he announced his peculiar ideas in botany, which formed the most constant object of his researches during the rest of his life. The Linnæan system, founded chiefly on the sex of plants, had at this time given a great activity to the study of the organs of fructification; and they were especially sought for with ardour in those rebel families of fungi, mosses, and ferns, which Linnæus had named *Cryptogamous*, because neither stamina nor pistils could be discovered in them. The opinion of that celebrated naturalist, who had considered the urns of the mosses as their anthers, no longer prevailed. In 1781, the Petersburg Academy had crowned a memoir by Hedwig, in which the urns were, on the contrary, considered as capsules, and the green powder which they contain as seeds; while the stamina were certain delicate filaments concealed in other parts of these plants. Most botanists appeared disposed to adopt these new ideas. In fact, the green powder, on being thrown on the earth by Hedwig, had germinated, and all that seemed to be wanting to the system of that naturalist, was its being applied to some genera to which he had not yet extended his observations. Notwithstanding these favourable appearances, M. de Beauvois was not satisfied with Hedwig's ideas, nor led away by the almost general assent with which they were received. The heterodox systems of MM. de Necker and Medicus, who would have the cryptogamic plants grow by a kind of spontaneous generation, or organic crystallization, were still less to his mind. *Omne animal ex ovo*, his master Linnæus had said, after Harvey, and whoever pretended to seek another origin for life, was in his eyes a blasphemer. Now the egg, added he, requires to be fecundated. Thus, not only have all plants seeds, but they have all stamina, or at least pollen, in order to fecundate these seeds. Such was M. de Beauvois's reasoning; and it was in accordance with this reasoning that he directed his observations, feeling assured, that, by patient investigation, he would discover what he thought demonstration had disclosed beforehand. He believed, in fact, that his hopes would speedily be realized.

The first cryptogamic plants in which he perceived organs which he considered as male and female, were the fungi, and especially the hydna, or those mushrooms whose pileus is bristled with points beneath. The base of each small point is furnished, at a certain period, with a powder, which he considered to be the pollen. The points themselves, which he took for stigmata, then bend to receive this fecundating powder. They afterwards rise, and become swollen; and there is at length discovered in their interior another powder, which M. de Beauvois considered as the seed. Something similar takes place in the agarics or lamellated mushrooms. It is in the interior of the lamellæ that the seeds are found; the pollen forms at the exterior, and is easily collected by placing a plate of glass under the mushroom at the moment when its head is developed. In the young clavariæ, there is at the summit a mammilla, from which a fine powder escapes, and is diffused over the surface of the plant. The latter is furnished with small warts, each of which contains seeds.

In the lycoperdons, all botanists have observed a powder which they have taken for the seed; but as it is very combustible, and floats on water, M. Beauvois preferred considering it as a pollen. He thought that the seed is contained in a more internal network, which has its exit by the same aperture as the pollen; and, in his opinion, it is at the moment when they issue together, that one of these powders fecundates the other. He afterwards compared this fecundation to that which the eggs of the frog experience at the moment when they are laid.

When the progress of the mind in men who have had original conceptions is attentively studied, it is frequently perceived that a first idea which has beamed upon them, has afterwards directed them in all their researches, and even in all their systems. In their works it every where reappears under various forms, and in the deficiency of experiments or facts, they employ their ingenuity in calling hypotheses to its aid.

This was precisely the case with M. de Beauvois. He was no sooner persuaded that the seed of certain mushrooms was ininternal, and smaller than their pollen, and that it could be fecundated, not in the ovary, and while yet tender and small, as the seed of all other plants is fecundated, but at the moment of its escape, and when already fully developed, than he applied his doctrine to the mosses.

In the midst of that green powder which fills the urns of the mosses, and which Hedwig considers as the seed, is a kind of nucleus or small axis, more or less inflated, named by botanists the columella.

Those who had observed its interior had only seen in it a more or less cellular parenchyma. M. de Beauvois thought he remarked in it very small grains, and immediately conceived these to be the true seeds. The green powder which fills these urns was, in his eyes, nothing else than the pollen. The motions of the ciliæ, with which the edges of the urn are furnished, were intended to compress this pollen against the seeds, in order to fecundate them at the moment when they are making their escape. And when it was objected to this view, that Hedwig had raised mosses by sowing the green powder, he replied, that undoubtedly Hedwig had sown, at the same time, without perceiving it, the other finer powder contained in the columella.

It will be obvious, that, to confirm an opinion so new, it would have been necessary not only to shew that this powder of the columella actually exists, but also to be able to sow it separately from the green powder. However, it does not appear that M. de Beauvois ever tried this latter experiment.

The same objection might be made to his opinion respecting the lycopodia. In these cryptogamic plants there are observed capsules very different from those of the mosses, and which contain an inflammable powder, well known from its being used in public exhibitions. This powder, which Hedwig also took for the seed, appeared incontestibly to M. de Beauvois to be the pollen; but among this powder are mingled some transparent bodies, which he considered as a kind of buds or bulbs, capable of producing new plants. These, in his opinion, were the bodies that had germinated in Hedwig's experiments. The true seeds are larger grains contained in small capsules, placed in the axillæ of the leaves of the lower part of the stem; but we do not know that he ever attempted to make them germinate, although the experiment was much easier than with those of mosses.

The Academy, whose principle it has always been to attend only to positive calculations or experiments, could not therefore consider the opinion which M. de Beauvois had submitted to it as demonstrated: and although M. de Jussieu, in his *Genera*

*Plantarum,*' and M. de Lamarck, in his *Dictionnaire de Botanique de l'Encyclopedie*, article *Champignon*, some time after published extracts of it, it did not at the time produce a great sensation among botanists.

It is true that the author had left France, and that ideas which are not presented and defended by him who has conceived them, are more liable than others to fall into oblivion. Truth itself requires patrons to be introduced with success to the world, however evident it may be; and still more are they necessary for views, the proofs of which are as yet incomplete.

M. de Beauvois was not aware of his being exposed to this risk when he determined to travel; but his passion for acquiring knowledge was greater than his passion for fame. The interest of his systems, the well founded hope of soon entering the Academy, seemed nothing to him compared with the honour of entering it with more splendid and more numerous titles.

He even left his estates and his family. His accounts were not settled, nor his debts cleared. He confided these matters, together with the management of his other affairs, to a young wife, whom he left in France, and whose inexperience did great injury to his fortune.

It was the reading of travels that had inspired him with this sudden passion. The account of Arabia by Niebuhr, and the touching recital which he gave of Forskal's death, transported him to such a degree, that he resolved to finish what the Danish naturalist had only commenced. He even intended, after arriving at the Red Sea, to traverse Africa, and return by Senegal or Guinea. And it is probable he would have engaged in this rash enterprise, had he been in the smallest degree encouraged by the government. But the Comptroller-General, M. de Calonne, after giving him a favourable reception at first, received him so coldly the second time, that he determined to ask no one's assistance again, and to undertake only what he could accomplish by his own resources.

An opportunity such as he desired soon presented itself.

There is at the bottom of the Gulf of Guinea, to the south of the river Formosa, of which a branch also bears the name of the river of Benin, a small kingdom allied or tributary to the kingdom of Benin, the inhabitants of which name themselves Jackeris, and which the Europeans call Oware or Awerri, perhaps from the Portuguese name Don Juan Alfonso d'Aveiro, to whom we owe its discovery. Towards 1784, a captain of a slave ship of the name of Lodolphe [*], who acted for the house of Brillantais Marion of St Malo, had inspired the king of this country with a desire to see a French factory established in it; and, for that purpose, the Prince had confided to him one of his subjects named Boudakan, whom he had even given him as his son, and desired him to bring him up in the European manner. Landolphe exhibited this pretended prince some time at Paris, clothed in the dress which people of quality then wore. He was presented to the king of France, and introduced to several respectable houses. On the hopes which the promises of this Negro excited, Landolphe obtained permission from the French government to establish a settlement; and a company of merchants supplied him with some funds for this purpose. The captain had formed an acquaintance with M. de Beauvois, and through him with M. de Jussieu, of whom he asked an experienced gardener to superintend his tillage. M. de Jussieu was occupied in looking for one, when, after some days, M. de Beauvois came to him to say, " I have found a man on whom I can rely: it is myself."

In fact his imagination had been filled with the idea that this hitherto little visited country would present in abundance the new productions which he longed to collect, and that he would not there be left to himself, as in those which he had first intended to visit. He found in it the additional advantage, that, being once firmly established on the coast of Africa, he could there procure more certain means of resuming his first plans, and of traversing that part of the world. It may easily be imagined, that he had no intention of entering into the service of the new company, either as gardener or in any other capacity. So far from accepting any thing, he made, at his own expence, considerable purchases of instruments, books, and furniture, and procured provisions of all kinds for himself and his people. He took with him two of his domestics, and communicated his enthusiasm to his brother-in-law, insomuch as to make him resolve to accompany him, and personally devote himself to all the fatigues and perils of the enterprise. The dangers of the climate, of which Landolphe did not leave him ignorant, had no more power over him than all the other reasons which might have induced him to remain, and he embarked at Rochefort, on the 17th July 1786, for a voyage which he had calculated upon lasting four years, but which numberless events prolonged far beyond that period.

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[*] The Memoirs of this officer have been published by J. S. Quesne, in 2 vols. 8vo. Paris, 1823.

The little squadron remained two months at Lisbon, eight days at Chamah, a Dutch factory on the Gold Coast, between Cape Three-Points and Cape Corse; two days at Koto, a Danish factory on the same coast, on the river Volta; and as many at Amokou, a French factory; and at Juida.

M. de Beauvois omitted no opportunities of collecting or of transmitting the products by all the vessels that he met with, to his master M. de Jussieu.

They at length arrived at the place where he hoped to find a more abundant harvest. The ships entered the river of Formosa, on the 17th November, and were received by the inhabitants of Oware, with the greatest cordiality; but scarcely had the new colonists disembarked, when they perceived, to their grief, that, to make a solid settlement in Africa, something more was necessary than to be invited by the Negro princes, and well received by their subjects.

All those inconveniences, of which so little is anticipated, when the thirst of gold or the ardour of discovery lead to distant climates, were accumulated upon them. The heat burnt them by day; the cold humidity was insupportable by night; sleep could not quiet their sufferings. Lying on the moist ground, enormous rats sported over their bodies, and devoured their provisions; the mosquitoes covered them with blood by their punctures; the Negroes, accustomed to these inconveniences, did not imagine it necessary to guard against them, and scarcely afforded them any assistance. Prince Boudakan, on whose protection such flattering hopes had been founded, ashamed of being no longer but a common man, avoided as much as he could his old friends from France. When his European clothes were worn out, he resumed all his former habits, and soon forgot the little knowledge of the French language which he had been taught. Presently the inundations which each tide threw out upon the ground appointed for the settlement, the pestilential stench of the mud which encumbered the edges of the river, threatened them with plagues more fatal than any they had yet experienced. That disease, so harassing to Europeans in the torrid zone, and which sometimes pursues them even to their own country, the yellow fever, soon made its appearance. M. de Beauvois saw his brother-in-law and the two men whom he brought with him, expire. He asserts, in his narrative, that, of three hundred French, who went out with him, there perished two hundred and fifty during the fifteen months that he remained at Oware. He himself escaped a premature death, only by being carried back to the vessel which remained in the roads, and which, although transformed into an hospital, was yet more healthy than the land. Two other attacks reduced him to a deplorable state of weakness. During all this time, however, he never lost courage. So long as his strength permitted, and he could have a Negro to accompany him or propel his canoe, he traversed the country by following the different branchings of the river which waters this kind of delta, collecting all that was interesting, either with respect to the moral history of the people, or for natural history. He not only saw the Court of the King of Oware, a prince somewhat less barbarous than those who live farther in the interior, but whose kingdom is of small extent, and his subjects poor and not numerous. After making a journey to Agaton, the first entrepot of the kingdom of Benin, he made a second to Benin itself, where he resided some time, and was entertained as well as received by the King. This Prince, whose states are about fifty miles in diameter, thinks himself the most powerful monarch in the world. His subjects go farther: they are convinced that he is a supernatural being. Not only, like those of the Grand Lama, have they the opinion that their sovereign always remains the same, that his soul only transmigrates from his body to that of his successor; but, surpassing the inhabitants of Thibet, they imagine that he never eats. M. de Beauvois was apprehensive of being very ill treated, for having manifested a curiosity to assist at one of his repasts. It is certainly one of the strangest political doctrines that any legislator could have established, to render the steward of the prince the necessary depositary of the first state secret; but a more cruel doctrine, which requires no secrecy, is that which among this people continually requires human sacrifices. They are still very numerous in Benin, and at the feasts to which M. de Beauvois was invited, he was more than once the unwilling spectator of them.

After studying as much as he could the manners of the Negroes of the interior, he returned to Oware, and left it by another route for Bono-Pozzo, the frontier town of the kingdom on the side next the desert. His project was to enter the desert itself, and traverse Africa, if he had found but a single person to accompany him; but his Negroes left him, and he at length found himself obliged to return to the settlement. His weakness, however, increased at each relapse, and a last attack reduced him to such a state, that his friend Landolphe saw no other means of saving him than to force him on board a slave-ship, bound for St Domingo. His departure having been scarcely anticipated, and the vessel already overloaded, he could only take his journals with him. All that he left in Landolphe's hands was destroyed in 1791, when the settlement was pillaged by the English, six months before the declaration of war. The very papers which he carried with him were burnt in 1793, in the conflagration of Cape François; and of the fruits of so many arduous labours, there only escaped the parts sent directly from Oware to M. de Jussieu, who carefully preserved them, and sent them untouched to his friend, after an absence of twelve years.

All his dangers, however, were not over when he left Africa. An ignorant and brutal captain was the means of protracting the voyage to a period of five months. Frightful calamities overwhelmed the crew. Out of 250 Negroes which the vessel carried, 180 were thrown overboard, having died of consumption and small-pox. M. de Beauvois, treated with barbarity by the captain, who thought him a spy of the privateers, was attacked with scurvy and an eruption of a virulent nature. He would infallibly have perished, had it not been for the attention of the cook of the ship. At length, on the 28th June 1788, he arrived at French Cape in St Domingo, in such a state of weakness, that a surgeon of the name of Durand, was the only man who would receive him into his house, and he did so, simply from a motive of humanity, and not to let him die without the consolations of religion.

The strength of his constitution seemed unable to retain life for more than a few days, when he had the happiness to learn that his uncle, the Baron de Falletière, was commander of the Mole St Nicolas, and occupied a healthy dwelling in the neighbourhood of that place. He was carried thither, and, from the change of air, the cares of friendship, and rest, gradually regained his strength. He even found this new residence so agreeable, that he purposed to sell all his property in France, and settle in America; and, as he had been unable to remain an African colonist, try to become a St Domingo one. We know from a distinguished officer who sometimes accompanied him, that he discovered near the Mole St Nicolas a new species of sage, of which great use has since been made in medicine. Notwithstanding all this, he did not lose sight of his ideas respecting the fructification of the cryptogamic plants, and we see that he sent to the editor of the Journal de Physique a memoir in support of them *.

The Island of St Domingo, although inhabited for more than a century by Frenchmen, was still so little known, that M. de Beauvois would have found no difficulty in multiplying his discoveries, and in rendering himself as useful to science there as he would have been in Africa, had not events quickly happened to him which rendered all scientific research impossible. Things were not in their ordinary state when he arrived there. Already in France, the people, excited by the disputes of the ministry with the magistracy, openly aspired to another system of government. The announcement of a speedy convocation of the States-General, transformed into hope what had been but an object of desire. The internal affairs of France were the only subjects that occupied the attention of the men desirous of change. A society formed in England, which procured ardent associates in France, strongly urged the abolition of the slave-trade. These proceedings soon reached to St Domingo. It was there quickly learned that the friends of the blacks held a considerable rank

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* Lettre sur la Formation des Champignons.—*Journal de Phys.* tom. xxxvi. p. 55.

among the men who sought to establish civil equality and political liberty in France; and, in the eyes of the colonists, the abolition of the trade could not fail speedily to introduce the abolition of slavery, or, at least, the equality of rights between the free men of colour and the whites. Now, the very idea of equality with a man of colour was more revolting to the pride of the whites than the abolition of slavery seemed to compromise their interests. Thus there was formed in the minds of the colonists that strange mixture of opposite ideas, by which alone the revolution of St Domingo can be accounted for: on the one hand, opposition to France, and to the agents of the King, which assumed the appearance of democracy; on the other, the contemptuous and aristocratic repulsion of the more natural demands of all those who retained any trace of mixed blood. The result is but too well known. The predominant party, among the whites, expelled or reduced to impotence the agents of the royal authority, at the same time that it made the men of colour undergo numberless humiliations. The latter, in their turn, avenged themselves with the fury which is characteristic of their blood and climate; and at length, the slaves of both, excited by the example of their masters, and aware of their strength, destroyed all who possessed any degree of pre-eminence from colour, fortune, or personal liberty.

It would seem that M. de Beauvois, who had only gone to Africa as a naturalist and philosopher, who had been witness of the horrible sufferings which the slave-trade inflicted upon the Negroes, who was not a colonist, and possessed no slaves, would naturally be more inclined towards the ideas of the friends of the blacks, or, at least, that he would not have declared against the humble pretensions of the free men of colour.

The case was quite otherwise; and this singularity is to be explained by the history of this voyage.

He had seen in Africa two-thirds of each tribe reduced to the most absolute slavery. He had been witness to the atrocious conduct of the chiefs towards these unfortunate beings, who were buried alive with their masters, whom superstition every where immolated in great numbers, and whose flesh is still sold in many countries. He himself had seen three of them butchered at a feast, which one of the Ministers of the King of Benin gave him; and soon after, fifteen sacrificed by the king himself. Filled with horror at such sights, it was natural that he should regard the slaves which were sold to the Christians, as more fortunate than those that remained in the country; and if he had known that in Africa there is no free man who is not liable to become a slave, either through the fate of war, or the so frequently unjust judgments of the great; if he had read the account lately given by Mr Bowdich, and seen those wretched creatures, who, before being sacrificed, have their cheeks and shoulders cut with knives, and who are thus dragged, all covered with blood, amid the crowds of a populace filled with joy at the sight; if he had known, that, at a certain day, and at a given signal, the King of the Ashantees, in order to procure the favour of the gods for his enterprises, causes to be suddenly slaughtered not only all the slaves, but all the free men that are met with in the streets, he would undoubtedly have extended his opinion to all the inhabitants.

He even thought that the slave trade, by giving value to men, would engage the Negro princes to spare them, and that without it these horrible cruelties would be multiplied to infinity; an opinion which seems confirmed by the discourse which the king of the Ashantees himself held with the last embassy which the English sent to him.

Thus, in his ideas, before the slave trade could be abolished, without doing more harm than good to the African Negroes, it would be necessary to begin with civilizing them, with giving employment to the overplus of their population. It would be necessary to destroy entirely among them the superstitions, which would assume a more extended empire the moment they were no longer opposed by interest. On this point, therefore, M. de Beauvois will not be taxed with inhumanity, and those who may think his humanity ill directed, will respect his intentions; but, perhaps, the same indulgence will not be shewn for the obstinacy with which he strove to withhold political right in the colonies from the free Negroes, and even from the free men of mixed colour.

We cannot deny that he participated in the haughty prejudices of the whites against them, and that he acted and wrote to support these prejudices. It was because, from what he had observed respecting the physical and moral constitution of the Negroes, he could never persuade himself that their race belonged to the same species as ours, or that they were capable of arriving at the same degree of civilization. It was not that he merely saw in them another skin, other hair, another form of the head and teeth, and another general constitution. In the most fertile soil, where the inhabitants were naturally of a mild disposition, with an inclination to hospitality, and a fondness for domestic pleasures, in a word, amid all the means of arriving at the most perfect state of social happiness, he had found them, without exception, given up to the most absurd and cruel superstitions, and sunk in the most beastly sensuality. At no period does history shew them to have been otherwise. Religion, that parent of civilization, had remained ineffectual in reclaiming them. He had seen, in the town of Oware, the cross, which the Portuguese missionaries had planted there, still worshipped, but as a fetiche. The altar and the consecrated vessels that had been left, were rendered subservient to the operations of magic; and, as he himself says, the temple of the true God devoted to the worship of the devil. The Mahometans, who had less repugnance to overcome in converting the Negroes, had not been more successful than the Christians; and all the influence that their priests acquired was to sell, at a high price, passages of the Koran written on bits of paper which they use as amulets. M. de Beauvois was therefore persuaded, that this humiliating and degraded state depends upon the very nature of the race; that this character is indelible; and that traces of it must be retained wherever there remains a drop of Negro blood.

He did not sufficiently remember that all men, and the whites as well as others, may be strongly influenced by the prejudices which they have imbibed in childhood. The Egyptians, whom no one will accuse of having wanted intellectual qualities, retained the worship of animals to the time of Constantine. The prince most celebrated by poets, at the most brilliant epoch of letters, the Emperor Augustus, sacrificed men to the manes of his adopted father, and twice refused festivals to Neptune, in order, as he said, to punish him for having twice destroyed his fleets. Who, after this, will venture to blame the king of the Ashantees or of Benin, and think that their ignorance or their cruelty depends upon their organisation? In fine, were it even true that the Negroes belonged to a different species from ours, would it not be enough to be rational and sensible to have a right to be treated as men? Enlightened nations have made laws to prevent cruelty to animals, and when we have to do with beings who speak, who love, and who weep like ourselves, to what purpose is it to dispute respecting their origin or their species? Besides, it is especially for the interest of the whites, their moral interest, that it is necessary to set free the blacks, for the greatest evil of slavery is perhaps the corruption which it produces in the masters.

Be this as it may, it will easily be comprehended into what party, a man arrived at St Domingo with such ideas, would necessarily throw himself. It was that which called itself the patriot party, and which is commonly called the party of St Marc, from the place in which the first general assembly in which it predominated was held.

M. de Beauvois was not of this first assembly; but he had been elected to the provincial assembly of the north, which sat at French Cape, and he supported there all the measures of the Assembly of St Marc. In the month of January 1790, this assembly of the north having re-established, by its private authority, the superior council of the Cape, which the king had suppressed some years before, it called to it M. de Beauvois, on whom his office of advocate conferred a title to that honour. This honour, however, was a cruel one, for he found himself constrained by it, in March 1791, to be one of the judges of the unfortunate Vincent Ogé, a mulatto, who, with several of his partisans, was condemned to a punishment, the very name of which makes one shudder, for the crime of having attempted to put in execution, by force of arms, the laws which the constituent assembly had passed in favour of his caste.

The party of the assembly of St Marc continuing to predominate among the white colonists, M. de Beauvois was named to the second colonial assembly, which met in August 1791, a disastrous epoch for St Domingo, when the free men of colour began to assemble in the western provinces, for the purpose of acquiring, by force, the civil rights which the whites persisted in refusing them; and when, almost at the same time, the black slaves rose in the northern province, and ravaged the plain of the Cape with fire and sword. The latter movement was the most appalling, and that which required the most decisive measures. M. de Beauvois armed himself, and commanded several detachments sent against the Negroes; but the numbers of the latter compensated for their ignorance, and they continued to gain ground. It was necessary to ask immediate assistance, not of France, which was too distant, and of which the men of St Marc had nothing to expect, but of the nearest European colonies, without distinction of nation, for the insurrection of the slaves threatened all. Deputations were repeatedly sent to Martinique, the Spanish part of St Domingo, Jamaica, and the United States.

In the month of October 1791, M. de Beauvois was dispatched to Philadelphia, along with a merchant of the Cape, named Payan, for the purpose of exciting the zeal of the French minister, M. de Ternan. He resided there nearly two years, employing the greatest assiduity in procuring funds and provisions for Cape Town, which the war with the Negroes frequently reduced to a state bordering upon famine.

But, in the interval, the revolution had followed its inexorable course. The ideas which prevailed in France left no hopes that the legislative assemblies should deal with the pretensions of the whites. The discontent of the latter was daily increasing. Commissioners sent from France, the too famous Polverel and Santhonax, being ill received by them, supported themselves by the mulattoes. The discord among the castes every where increased; and, on various occasions, manifested itself by bloody combats. At length, after several months of disorder, the commander of the troops, Galbaud, gained over by the party of St Marc, having declared against the commissioners, was, by their order, sent under arrest to the fleet. Prisoner as he was, he succeeded in making the crews mutiny; and, with them, made a descent upon Cape Town; obtained possession of the forts, and put the commissioners to flight. The mulattoes, in order to assist them, raised the slaves. Galbaud, in his turn, with his officers, retreated to the ships. The sailors and Negroes, equally without leaders, vied with each other in plundering; and, amid this confusion, on the 21st June 1793, Cape Town became the prey of a dreadful conflagration.

M. de Beauvois, whom the commissioners had recalled from his mission, arrived from the United States the third day after this event.

A thick smoke still covered the town. He traversed it amid ruins and dead bodies, and, what appeared still more frightful to him, amid bands of slaves of both sexes, delivered up to all the madness of drunkenness and debauch. In this manner, he arrived at the burning remains of the abode which he had occupied, and found in it only the ashes of those collections in making which he had consumed so many years, and endured so many sufferings.

But the state in which, on his return, he found his property and his adopted country, was not the last of his miseries.

The commissioners, entering the city in triumph, at the head of the men of colour, caused all the whites to be arrested who had been members of the magistracy. The magistrates of the superior council, who were the more particular objects of the vengeance of the mulattoes, on account of the judgment which they had pronounced against Ogé, were put in prison. M. de Beauvois, who was one of them, was confined for several days with the dean of the council, an old man of eighty, in a damp cell, where they were devoured by rats and cockroaches. Incessantly threatened with death, he was so fortunate, through the agency of a mulatto woman, who had belonged to his uncle, to be only doomed to transportation from the colony; but he was prohibited from appearing there again, until four years after the general peace. He made all haste to flee, reckoning upon yet finding, on board his vessel, the effects which he had brought with him from the United States. Vain hope! the vessel had sailed for Port-au-Prince, and, on the way, was taken by English privateers. Lastly, to complete his misfortunes, the ship, in which he was transported, was itself taken by another English privateer, and the passengers plundered of all that remained to them. All that they left with M. de Beauvois was a small trunk, in an opening of which he fortunately observed a freemason's diploma. It was with this trunk, and ten francs in money, that he returned to Philadelphia.

The French ministers of this period took care not to receive any of the St Domingo exiles. He could obtain no assistance from France, where he had been inscribed in the list of emigrants, and his effects confiscated. His only resource in this country, where a few weeks before he had been invested with a sort of diplomatic character, was to engage himself as a musician to a man who had an equestrian and rope-dancing establishment at Philadelphia. Still, says he, in his notes, had the spectators only known something of music! but when any of Haydn's fine symphonies were performed, the populace in the galleries overwhelmed the musicians with roasted apples and filth; and called for Marlborough, and other airs of the same kind. But in all situations, the sciences bring consolation; wherever there are enlightened men, they may rely on support. A quaker physician, who had some knowledge of natural history, Dr Wistar, received the unfortunate French naturalist with the charity for which his religion is distinguished; and, at the same time, with the interest inspired by so many sufferings in the cause of science. Mr Peale, a painter, who had established a museum of curiosities at Philadelphia, was very glad to have them arranged by a European naturalist; and scarcely had M. de Beauvois thus procured some pitiful means, when he began to give lectures, and to collect the productions of this third climate, with as much courage as if he had not already twice seen the results of his labours destroyed.

Who would not be affected by such resignation, and such unalterable ardour? And could it be possible, with such a man, to bring in remembrance the party which he had followed?

The New French minister, M. Adet, was not of this mind. Himself a man of science, in a courageous cultivator of the sciences, in an old correspondent of the Academie des Sciences, he saw only a Frenchman; and expecting that his country would render him justice, he lavished assistance upon him, and patronized all his undertakings.

His first excursions were made in the south-western provinces, among the Creeks and Cherokees, principally with the view of making inquiries respecting the fur trade. There he found savages poorer, perhaps ruder, than Negroes; but whose superstitions were not so barbarous. They do not sacrifice their fellows, but they still exercise the law of retaliation. A murder can only be expiated by a murder; and when the first author of the crime cannot be found, one of his parents must be put to death. With the whites, they do not even look to genealogy; and all are in their eyes of the same family.

M. de Beauvois arrived in one of their little towns at the moment when one of them had been killed by a colonist; and he would have paid the forfeit of his life for all the men of his colour, had not his interpreter succeeded in making them understand, that having come from France, he did not belong to the family of the United States. They then treated him with friendship; but their friendship had nearly done him as much harm as their hostility had threatened to do. In an attack of fever, they wished him to take the remedies which they themselves used in such cases; and their effect was so violent, that he almost became a victim to his docility.

Some French families, which had originally come from Louisiana, are, as it were, lost in these countries at a distance from the coasts. M. de Beauvois discovered Protestants there, who had left France at the period of the revocation of the edict of Nantes, and who had almost adopted the manners of the natives. He conceived it would be easy to establish an intercourse with them which might have put us in possession of their fur trade.

Having come into America a true zoologist, he did not content himself with observing the fur animals. The rattlesnakes, those reptiles to which the most extraordinary properties had been attributed, independently of their formidable poison, were to him a peculiarly interesting object of inquiry. He was witness to the fact, that the female serpents, at the moment of danger, afford an asylum to their young in their mouths.

His collections of all kinds were very rich; he did not even neglect to collect fossil bones; and it is to him that we are indebted for the knowledge of the teeth of the megatherium of Mr Jefferson, a knowledge which completed that of the extinct animal.

But as if an inexorable fatality pursued him, his whole treasures which were embarked in a vessel carrying English prisoners to Halifax, and which ran aground near the harbour, were either plundered or swallowed by the waves.

It was in the midst of the vexation occasioned by this last loss, that he at length learned that the government of his country was appeased with respect to him; and that France was again open to him. The Institute, which had just been formed;

had used its influence in behalf of a man, who, in some measure, belonged to it, and its demand was heard. Hastening to profit by this act of justice, M. de Beauvois abandoned a journey which he was just about to undertake to the Akansas. Taking with him the little that remained of his collections, he landed at Bordeaux in August 1798. Thus ended twelve years of travels, and, it may be said, of misfortunes; for none of these twelve years passed over without his having encountered great dangers, experienced great losses, and been subjected to vexations more injurious, perhaps, than the hazards and losses themselves.

It will easily be imagined, that, after his adventures in St Domingo, he would long keep free of public affairs. Collecting the remains of his fortune, and those of his collections, devoting to his works the remainder of his life, he still saw passing under his eyes greater and as bloody revolutions, although less sullied by crimes; and he, no doubt, had more than one occasion to bless the misfortunes which had caused him to devote himself entirely to science. After his return to France, it was in fact his sole occupation.

The herbarium and insects which he had sent from Oware to M. de Jussieu in 1788, compensated in part for the collections which he had lost, and served as a basis to his Flora of Oware and Benin * and to the greater part of his insects collected in Africa and America.

Favoured with the protection of an enlightened government, these two works were executed with magnificence. They make known to naturalists species remarkable for their beauty, their singularity, or their utility. If the number is not great, it ought to be remembered, that there only remained to the author the wrecks that had escaped from his unfortunate adventures.

Two other works, the Prodrome d'Æthegamie †, and the Essai d'Agrostographie ‡, have shewn that M. de Beauvois was

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* Flore d'Oware et de Benin en Afrique. Paris, 1804-1820. Nineteen numbers, folio.

2. Insectes recueillis en Afrique et en Amerique, dans les royaumes d'Oware et de Benin, a Saint-Domingue et dans les Etats-Unis, pendant les années, 1785-1797. Paris, 1805-1820. Twelve numbers, folio.

† Prodrome des cinquième et sixième familles de l'Ætheogamie, les Mousses, les Lycopodes. Paris, 1805. 8vo.

‡ Essai d'une nouvelle Agrostographie, ou nouveaux genres de Graminées, avec Figures représentant les caractères de tous les Genres. Paris, Fain. 1812, 8vo. et 4to.

also capable of rising to more general considerations; and that none of the more difficult questions of botany were unknown to him.

But his printed writings are not the only ones which he intended for the public. We have seen among his papers very extensive treatises on various branches of the history of animals and plants. He had nearly completed the relation of his travels in Africa, and had begun those in the United States. He had engaged in the study of vegetable physiology, and several times communicated observations in that department to the Academy, of which we have taken notice in the annual reports. What remained to him of his collections, after all his losses, were still of importance. In a word, there was nothing wanting to him to enable him to occupy himself usefully both for himself and the public during a long life, had nature granted him one; and nothing seemed to render the contrary probable. His health was good, his life regular, his habits simple and moderate, and he employed temperance even in his studies. All these appearances were deceitful. The sudden change of temperature which happened at the commencement of the present year, occasioned an inflammation of the chest, which, in defiance of all the efforts of art, carried him off in five days. He died on the 21st January 1820, leaving no children, although he had been twice married.

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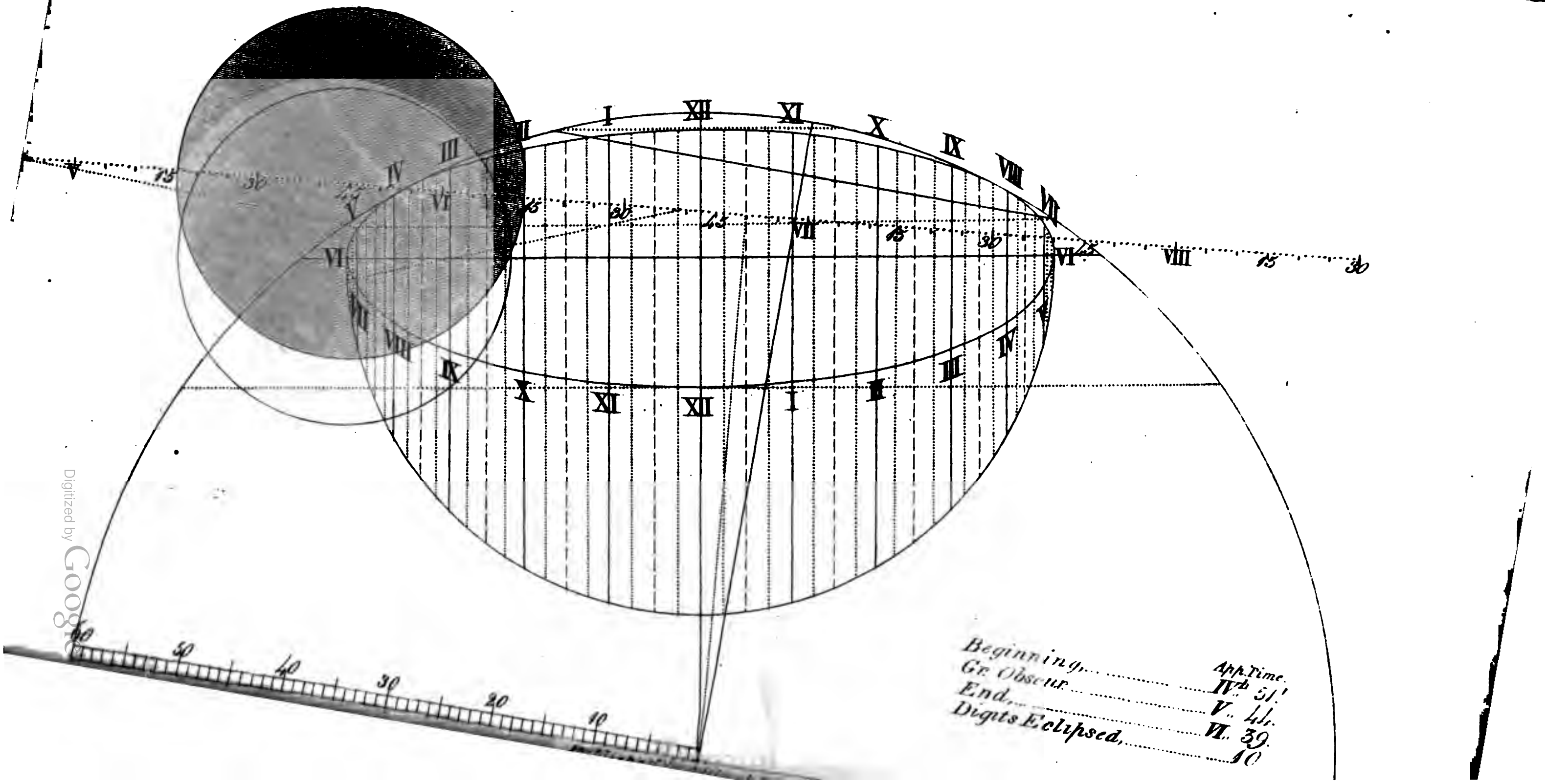
## *On the general presence of Spiral Vessels in the Vegetable Structure; and on the peculiar Motion observable in detached pieces of the living Bark of Urtica nivea.* By Mr DAVID DON, Libr. L. S. &c. Communicated by the Author.

It has been generally believed that spiral vessels are rarely found in the parts of fructification; but repeated observations have convinced me that they are to be met with in almost every part of the vegetable structure. I have found them in the calyx, corolla, filaments, and style of *Scabiosa atro-purpurea* and *Phlox;* in the calyx and petals of *Geranium sanguineum;* in the perianthium of *Sisyrinchium striatum;* in the capsule and styles of *Nigella hispanica.* They are also present in the pericarpium of *Onagrariæ*, *Compositæ*, and *Malvaceæ.* I have been led to these remarks by the ingenious observations of Mr Lindley in a late number of the Botanical Register, on the structure of the seeds of *Collomia*, which he has shewn to be enveloped by a plexus of spiral vessels. These vessels in *Polemoniaceæ* appear to be analogous to the coma or pappus with which the seeds of certain *Bignoniaceæ*, *Apocineæ*, and *Malvaceæ* are furnished; but further observations seem necessary before we can conclude that they are true spiral vessels. Spiral vessels are most abundant in the stems of *Urtica nivea*, *Centaurea atro-purpurea*, *Heliopsis lævis*, *Helianthus altissimus*, *Aster Novi Belgii* and *salicifolius*, in all which they are distinctly visible to the naked eye, and on this account these plants may be recommended as furnishing the most beautiful examples of spiral vessels for the student in botany. The stalks, when torn gently in a longitudinal direction, and a small peg placed in the top of the fissure, exhibit the spiral vessels much more distinctly than by a transverse fracture. Sometimes the folds of these vessels were found seated in the pith, both in *Malope trifida* and *Heliopsis lævis*, but they were easily traced to their origin among the woody fibres. No trace of them has been found in the outer bark, but they abound in the liber or inner bark of *Pinus*, as well as in the albumen. I have never been able to detect them, however, in the leaves of this genus, nor of *Podocarpus*, and they appear to be of rare occurrence in the leaves of evergreen trees in general. The stems and leaves of *Polemoniaceæ*, *Irideæ*, and *Malvaceæ* are also abundantly supplied with spiral vessels; but perhaps in no family do they abound so much as in the *Compositæ*. They are rare in *Cruciferæ*, *Leguminosæ*, and *Gentianeæ*.

I have frequently remarked, on detaching the spiral vessels from the young vigorous shoots of herbaceous plants, that they became violently agitated. The motion continued for some seconds, and appeared to me to be attributable to the effect of the living principle, analogous to what takes place in the animal economy, and not to a mere mechanical action.

While holding between my fingers a small segment of the bark of *Urtica nivea*, which I had just then detached from the living stem, my attention was instantly attracted to the peculiar spiral motion which it exhibited. The experiment was repeated several times successively with other pieces of the bark, and the

## for Edinburgh, of the Solar Eclipse, July 17th 1833.



| | App. Time. |
|---|---|
| Beginning | IVh 51′ |
| Gr. Obscur. | V. 44. |
| End | VI. 39. |
| Digits Eclipsed, | 10 |

motion was in every case similar to the first. It was evidently the effect of the contractile force of the living fibre, as the motion ceased after the pieces of bark had been held in my hand for a few minutes. This short notice may direct the attention of naturalists to this curious phenomenon.

## *On the Great Solar Eclipse which will take place on the 17th July 1833, being the principal Results of a Calculation for Edinburgh Observatory.* With a Projection. By Mr GEORGE INNES, Aberdeen.

THIS will be a great eclipse to all parts of Great Britain, and nearly total on the north-west coast of Scotland. The central path of the penumbra will pass near to the south-east coast of Iceland; and the greater part of that island, although the sun is for some weeks above its horizon at that season, will be involved in total darkness. The central path will pass nearer to the equator at other places, according as they are situated farther to the westward.

In calculating the elements of this eclipse, the Solar Tables of DELAMBRE, and the Lunar Tables both of BURCKHARDT and DAMOISEAU were used; but in calculating the times of the eclipse for Edinburgh, those of DAMOISEAU were used. The elements are calculated for $5^h$, $6^h$, and $7^h$, Greenwich *mean time*, civil reckoning. The Longitude used for Edinburgh Observatory, 12′ 41″,4, seems to be two or three seconds less than the truth. $\frac{1}{309}$ was used for the reduction of the Latitude, and also for the Moon's Parallax.

It may be proper to state, that no allowance has been made to the sun's semi-diameter for irradiation, nor to that of the moon for inflexion, as I found some late observations would have agreed better with my previous calculations, had I omitted these doubtful corrections; but since making the calculations of this eclipse, I have learned that an error has been discovered in the *epochs* of the Sun's Longitude, as given in the Solar Tables of DELAMBRE. It therefore appears, that, after correcting the Solar Tables, the calculation of Solar Eclipses and Occultations will agree better with the observations, when the irradiation and inflexion are applied.

| The ELEMENTS obtained by using **Delambre's** Tables of the Sun, and **Burckhardt's** Tables of the Moon: | | | | By using **Damoiseau's** Tables of the Moon, reduced to the sexagesimal division of the circle. | | |
|---|---|---|---|---|---|---|
| Greenwich *Mean Time*, Civil Reckoning. | At v. hours. | At vi. hours. | At vii. hours. | At v. hours. | At vi. hours. | At vii. hours. |
| Sun's Longitude from Apparent Equinox, | 114° 17′ 58″,69 | 114° 20′ 21″,828 | 114° 22′ 44″,97 | | | |
| —— Right Ascension in Arc, | 116 12 22,47 | 116 14 53,67 | 116 17 24,87 | | | |
| —— —— —— in Time, | 7ʰ 44 49,498 | 7ʰ 44 59,578 | 7ʰ 45 9,658 | | | |
| —— Declination, North, | 21° 16 29,28 | 21° 16 4,15 | 21° 15 39,02 | | | |
| —— hourly motion in Longitude, | 2 23,137 | 2 23,138 | 2 23,139 | | | |
| —— —— —— in Right Ascension, | 2 31,200 | 2 31,200 | 2 31,200 | | | |
| —— semi-diameter, | 15 45,97 | 15 45,97 | 15 45,97 | | | |
| —— horizontal Parallax, | 8,66 | 8,66 | 8,66 | | | |
| Apparent Obliquity of the Ecliptic, | 23 27 36,85 | 23 27 36,85 | 23 27 36,85 | | | |
| Equation of *Mean* to *Apparent Time*, | 5 42,801 | 5 43,024 | 5 43,247 | | | |
| Moon's Longitude from Apparent Equinox, | 112 59 33,14 | 113 36 38,56 | 114 13 44,34 | 112° 59′ 22″,505 | 113° 36′ 27″,069 | 114° 13′ 32″,985 |
| —— Latitude, North, | 43 2,59 | 46 26,36 | 49 49,64 | 43 4,130 | 46 27,751 | 49 51,158 |
| —— Equatorial horizontal Parallax, | 1 0 35,26 | 1 0 36,32 | 1 0 37,31 | 1 0 33,965 | 1 0 34,972 | 1 0 35,957 |
| —— horizontal semi-diameter, | 16 30,60 | 16 30,89 | 16 31,16 | 16 30,255 | 16 30,530 | 16 30,798 |
| —— hourly motion in Longitude, | 37 4,217 | 37 5,511 | 37 6,798 | 37 2,197 | 37 4,623 | 37 6,980 |
| —— —— in Latitude, + | . . . . | . . . . | . . . . | 3 23,532 | 3 23,441 | 3 23,311 |
| Inclination of Relative Orbit, | . . . . | . . . . | . . . . | 5 35 28,4 | 5 34 58,1 | 5 34 20,1 |
| Moon's hourly motion in Relative Orbit, | . . . . | . . . . | . . . . | 34 49,00 | 34 51,20 | 34 53,74 |
| True Ecliptic Conjunction of the Sun and Moon, | . . . . | . . . . | . . . . | 7ʰ 15′ 53″,76 | At Conj. Lon. of ☉ & ☽<br>—— Moon's Lat. | 114° 23′ 22″,95<br>0 50 45,02 |

*TABLE of the Principal Results obtained in calculating for* EDINBURGH *Observatory,* Lat. 55° 57′ 21″ N.; Long. *in time,* 12′ 44″,1 W.

| | the Beginning. | | For the greatest Obscuration and Apparent Conjunction. | | | For the End. | |
|---|---|---|---|---|---|---|---|
| | H. ′ ″ | H. ′ ″ | H. ′ ″ | H. ′ ″ | H. ′ ″ | H. ′ ″ | H. ′ ″ |
| Instants assumed, EDIN. *Appar. Astron. time,* | 16 50 35,766 | 16 51 35,762 | 17 43 35,561 | 17 44 35,565 | 17 45 35,561 | 18 38 35,364 | 18 39 35,360 |
| Sun's Longitude, . . . . . . . . . . | 114°18 20,162 | 114°18 22,546 | 114°20 26,599 | 114°20 28,985 | 114°20 31,370 | 114°22 37,813 | 114°22 40,199 |
| —— Right Ascension, . . . . . . . | 116 12 45,15 | 116 12 47,67 | 116 14 58,71 | 116 15 1,23 | 116 15 3,75 | 116 17 17,31 | 116 17 19,83 |
| Right Ascension of the Meridian, . . . . | 8 51 41,6 | 9 6 44,1 | 22 8 52,2 | 22 23 54,7 | 22 38 57,2 | 35 56 7,8 | 36 11 10,2 |
| Moon's true Longitude, . . . . . . . | 113 4 55,889 | 113 5 32,939 | 113 37 41,226 | 113 38 18,306 | 113 38 55,388 | 114 11 41,642 | 114 12 18,755 |
| —— true Latitude, . . . . . . . . . | 0 43 34,658 | 0 43 38,049 | 0 46 34,532 | 0 46 37,923 | 0 46 41,313 | 0 49 40,992 | 0 49 44,381 |
| Altitude of Nonagesimal, . . . . . . . . | 43 36 27,2 | 43 41 16,4 | 47 36 36,9 | 47 40 50,0 | 47 45 2,4 | 51 9 25,8 | 51 12 54,5 |
| Longitude of Nonagesimal, . . . . . . . | 36 20 10,3 | 36 30 14,5 | 45 9 23,2 | 45 19 18,5 | 45 29 14,7 | 54 13 41,7 | 54 23 34,7 |
| Parallax in Longitude, + . . . . . . . | 40 35,083 | 40 37,181 | 41 37,633 | 41 37,846 | 41 38,031 | 40 57,028 | 40 55,293 |
| —— in Latitude, . . . . . . . . . . | 43 39,283 | 43 35,777 | 40 37,658 | 40 34,382 | 40 31,113 | 37 45,065 | 37 42,152 |
| Apparent diff. Long. ☉ and ☽, . . . . | 32 49,190 | 32 12,426 | 1 7,740 | 0 32,833 | 0 2,049 | 30 0,857 | 30 33,849 |
| Moon's apparent Latitude, *North*, . . . | *south* 0 4,625 | *north* 0 2,272 | 5 56,874 | 6 3,541 | 6 10,200 | 11 55,927 | 12 2,229 |
| —— apparent semi-diameter, . . . . | 16 33,102 | | 16 35,289 | | | 16 37,636 | |
| Apparent motion ☽ from ☉ during 60 sec. | 36,767 | | 34,907 | 34,882 | | 32,995 | |
| Errors, from Instants assumed, . . . . | — 30,123 | + 6,644 | — 1 7,740 | — 0 32,833 | + 0 2,049 | — 5,658 | + 27,337 |
| TIMES obtained, *Civil Reckoning*, . . . | H. ′ ″<br>4 51 24,920 | | Greatest Obscuration, H. ′ ″ 5 43 34,891<br>Apparent Conjunction, 5 45 32,038 | | | H. ′ ″<br>6 38 45,644 | |

The final results are as follows:

| | D. | *Mean Time.*<br>H. ′ ″ | *Apparent Time.*<br>H. ′ ″ |
|---|---|---|---|
| The Eclipse begins, | July 17. | 4 57 7,76 | 4 51 24,92 |
| Greatest Obscuration, . . . . . | | 5 49 17,93 | 5 43 34,89 |
| Visible Conjunction, . . . . . | | 5 51 15,08 | 5 45 32,04 |
| End of the Eclipse, . . . . . . | | 6 44 38,88 | 6 38 45,64 |

Digits eclipsed at Greatest Obscuration, 10 dig. 0 31,88, on the north part of the Sun's Disc.
The Moon will enter the Sun's Disc on the west limb, at 46° 41′ from his vertex, in reference to the horizon.

## *On the Velocity of Sound.*

The discordance between the theoretical and experimental velocities of sound has been a subject of inquiry among scientific men since the theory was first started by the illustrious Newton down to the present time. It is no disparagement to this great philosopher to have left the subject in the state he did, when we consider the scanty data he had to go upon. Since his time, some advances have been made towards a nearer approach between theory and experiment; not, however, in such a way as to be free from objection. For the theory is, in various particulars, by no means settled on so sure a basis as might be wished. Fully to investigate the subject, may be a task reserved for a future age; if, indeed, the phenomena of sound be susceptible of thorough investigation. At present I shall throw out a few hints, which, if they do not fully explain, may serve to render the discordance between theory and experiment less wonderful, or may rather, perhaps, excite our wonder that any near approaches should have been made to agreement at all.

Sir Isaac Newton laid it down as a general principle, regulating the propagations of undulations through elastic media, that the square of the velocity of such propagation is directly as the elasticity of the medium, and inversely as its density. That there may be something in this theory I would not dispute; but I suspect it to be of very circumscribed application. In the absence of any thing like satisfactory proof, I should think it can, at most, be true when the elastic medium is perfectly homogeneous and unmixed, and when the length of the vibrations bears the same proportion to the distances between the particles in a state of equilibrium *.

Most of the eminent philosophers who treat on the subject, have, without any such scruple or limitation, admitted this theory. They have, for instance, done so, whether in estimating the separate effects of density, of pressure, temperature, or humidity, on the rate of the propagation of sound through the atmosphere; they have assumed the theory to be true, whether the elastic medium be a simple gas, or, like the atmosphere, a compound of oxygen, azote, moisture, &c.; and they have taken for granted, that the duration of a vibration has nothing to do with its extent. These are most important points, but which have neither yet been, nor are likely soon to be, proved; and, until something more substantial than opinions or conjectures be advanced in their behalf, the theory must, in a great measure, rest on a slippery foundation. Mankind, it is true, do not all run to the same extreme; for some reject the theory of sound in the lump, just as they do every thing which it would be too troublesome to examine.

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* See Art. Acoustics.—*Sup. Encyc. Britan.*

If, as some philosophers suppose, gases and vapours, when mixed, but uncombined, be as if *in vacuo* to each other, should not each ingredient of a mixed medium have a propensity to propagate the same sound with a velocity peculiar to itself? and should not the confusion occasioned thereby tend to render the sound indistinct, if not soon to annihilate it altogether? The remarkable distinctness and audibility of sound at low temperatures, may therefore be partly owing to the comparative simplicity of the medium; because then the air necessarily contains little moisture. Hence, when the temperature has sunk, and the dew fallen, sound is better heard. Some, to be sure, ascribe all this to the more uniform temperature of the atmosphere during night; but, so far as mere loudness is concerned, I should rather ascribe it to the greater density of colder air.

Since the elasticity of air containing the same proportion of moisture is exactly as its density, when under the same temperature, it readily follows, on the theory stated above, that the velocity of sound should, at the same temperature, be precisely the same in air containing a like proportion of moisture, in every latitude, and at every height above the level of the sea. Another consequence is, that the height of the barometer has nothing to do with the velocity of sound in dry air; and, in no case whatever, under the same temperature, should the velocity increase or decrease when the barometric pressure alone does so, but rather the reverse. All this will be rendered evident by exhibiting the most approved formula for the velocity of sound, as given by Newton, on the principle above stated, and remodelled by Laplace, viz.

$$V = \sqrt{\frac{gP}{D}} \times \sqrt{k}$$

where $g$ is the velocity which a heavy body acquires by falling during one second, P the barometric pressure *, D the density of air, compared with that of mercury at 32° Fahrenheit, as unit, and $k$ the ratio between the quantity of heat which would raise the temperature of a mass of air one degree, if free to expand under the same atmospheric pressure, and what would raise it one degree, if confined in a close inextensible vessel. A mean of four experiments of MM. Gay Lussac and Welter gave this ratio as 1.3748 to 1; but many experiments of my own make it as 4 to 3. The former requires the particles of air to repel each other, with forces inversely as the 2.1244 powers of their distances,—a most improbable law, to be sure, having no known parallel in nature; whereas the latter implies, that the repulsion varies inversely as the square of the distance; which, indeed, is the only law known, and most likely the only one which exists. For these reasons, I have little hesitation in adopting the ratio of 4 to 3, as the true value of $k$.

An expression for D may be obtained in terms of P, $g$, and $t$, the Fahrenheit temperature, thus: The density of dry air varies, as P for pressure, as $g$ for gravity, and inversely, as $448° + t$, for temperature, according to the experiments of Mr Dalton, M. Gay Lussac, &c.; but the additional expansive force of moisture $f$, makes the density vary for pressure not exactly as P, but as $P-\frac{5}{8}f$; because, according to M. Gay Lussac, the density of aqueous vapour, is to that of dry air, in like circumstances, as 5 to 8. Wherefore, combining these together, the density varies, as

$$\frac{(P-\frac{5}{8}f)g}{448+t}$$

Let D′ be the density of dry air at the freezing point, and under a pressure of 30 inches, at some place where the intensity of gravity is $g'$, then

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* The place which P occupies here has led several into the mistake of supposing that Newton, Laplace, and other theorists, made the velocity of sound vary as the square root of the barometric pressure, when the temperature is the same. It should be recollected, that D involves P; but, as we shall presently see, it likewise involves $g$; and therefore, this formula is independent of the latitude, or height above the sea.

$$\frac{30\,g'}{480^\circ} : \frac{(P-\frac{5}{8}f)g}{448^\circ+t} : : D' : D = \frac{16(P-\frac{5}{8}f)\,g\,D'}{(448+t)\,g'}$$

$$\text{Hence } V = \sqrt{\frac{P(448+t)\,g'}{16(P-\frac{5}{8}f)D'}} \times \sqrt{\tfrac{4}{3}} = \sqrt{\frac{P(448+t)}{P-\frac{5}{8}f}} \times \sqrt{\frac{g'}{12\,D'}}$$

The last factor is constant, and its value may be had by inserting those of $g'$ and $D'$ for any place where they are known. Those for London will make it about 48.3. Hence, Laplace's general formula becomes, for any place,

$$V = 48.3\sqrt{\frac{P(448^\circ+t)}{P-\frac{5}{8}f}}, \text{ in English feet.}$$

Here, since $f$ is always small compared with P, it is manifest, that when P alone varies, it must do so in a great degree to affect V; and, even then, V will vary in the opposite direction. It is therefore evident, that Newton and Laplace did not, as some suppose, make the velocity of sound vary as the square root of the barometric pressure, when $t$ and $f$ are constant.

I am not aware of any experiments having been made which could enable us to ascertain whether or not the variations of barometric pressure, considered separately, affect the velocity; for either the ranges have been too short, and of course the velocity uncertain, from the uncertainty of at least a tenth of a second in the minute interval of elapsed time; or the effects of wind have been left undetermined, in all cases with which I am acquainted where the barometer has been known to have varied materially. As, however, I suspect the velocity to be greater when the sound is more intense, I should expect that the barometric pressure will be found to have some influence; and that, for the same reason, the velocity should vary in a less ratio than $\sqrt{(448^\circ+t)}$ for temperature. A comparison of Mr Goldingham's experiments in the torrid zone with those which have been made in the Arctic expeditions, goes far to establish the latter conjecture. Experiments could even be made through a considerable range, both of temperature and pressure, within the temperate zones, by operating at different seasons of the year, and at different heights above the level of the sea. Careful experiments, varied in this way, would throw infinitely more light on the subject than all the abstract theories in the world.

I formerly stated my apprehensions regarding the uncertainty which attaches to the direct measurement of small intervals of time. In this opinion I do not stand alone; for it has been often stated as an insuperable limit to consummate accuracy in astronomical observations, that the precise moment when any phenomenon occurs cannot be noted with much exactness. There have of late years been many attempts to remedy this; and, so far as instruments are concerned, I dare say something has been done, or is farther practicable. However, when we attend to any case which admits of having its accuracy examined, it does not appear that an interval of time can be noted with certainty to the tenth of a second. In the experiments which were made in France, on the velocity of sound in 1822, the elapsed intervals were separately noted by three, and sometimes by four observers of the first eminence, provided with superior instruments. So far, however, from their results according to a negligible fraction, they often differ by three, or four, and sometimes by five-tenths of a second. In the experiments made in Holland, in 1823, the observers were not so numerous as to enable us to form any opinion on this point. At Port Bowen, Captain Parry and Lieutenant Foster have severally noted the intervals, and their results in the accompanying Table, differ by one, two and three-tenths. But since each of these results is generally the mean of six observations, the difference would often exceed three tenths for a single observation. When the interval of elapsed time amounts to from 50″ to 60″, such an error is of no great importance, but on two or three seconds it changes the result entirely.

It may be useful to subjoin the general results which were obtained in the very interesting experiments made on the velocity of sound in the northern expeditions. Some complain that no hygrometers were used in these experiments; others consider the omission of no moment, alleging that the quantity of moisture contained in the air at these low temperatures must have been too minute to affect the velocity of sound materially. I rather incline to the latter opinion; but on two points which it involves, we are far from being well informed. We do not know how much moisture may be contained in air at low temperatures, only it cannot be great; and we are still more ignorant regarding the precise effect which moisture really exerts on sound at any temperature, there being no such thing as making experiments on sound in perfectly dry air.

The value of the experiments made during the Arctic expeditions, will be better appreciated while we consider the number and magnitude of the discouragements under which they were achieved. They cannot, it is true, be said in every respect to equal the researches which have been prosecuted on a more extended scale, in temperate regions; but still the results are interesting, as affording farther evidence of the insufficiency of the most refined theories hitherto proposed.

The following Table is a summary of the results obtained at Port Bowen, by Captain Parry and Lieutenant Foster, by means of a brass six-pounder, over a range of 12892.89 feet. The sound came in the direction of S. 71° 48′ E.

| Date. | Wind. | | Barom. Inches. | Temperature Fahrenheit. | Shots. | Intervals Elapsed. | | | Velocity per Second in Feet. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Parry. | Foster. | Mean. | |
| 1824. | | | | | | | | | |
| Nov. 24. | E SE, | light, | 29.841 | — 7° | 5 | 12″.3525 | 12″.43 | 12″.3912 | 1040.49 |
| Dec. 8. | N, NE | squally, | 29.561 | — 9 | 6 | 12.331 | 12.5266 | 12.4288 | 1037.34 |
| 1825. | | | | | | | | | |
| Jan. 10. | E SE, | light, | 30.268 | — 37 | 4 | 12.5889 | 12.47 | 12.529 | 1029.01 |
| Feb. 7. | NE | light, | 29.647 | — 24.5 | 6 | 12.639 | 12.6167 | 12.6278 | 1020.99 |
| 17. | | calm, | 29.598 | — 18 | 6 | 12.372 | 12.44 | 12.406 | 1039.25 |
| 21. | | calm, | 29.735 | — 37.5 | 6 | 12.8167 | 12.7067 | 12.7617 | 1010.28 |
| Mar. 2. | easterly, | light, | 30.398 | — 38.5 | 6 | 12.64 | 12.78 | 12.71 | 1014.39 |
| 22. | westerly, | light, | 30.258 | — 21.5 | 6 | 12.4 | 12.7167 | 12.5583 | 1026.64 |
| June 3. | easterly, | light, | 30.118 | + 33.5 | 6 | 11.7333 | 11.744 | 11.7387 | 1098.32 |
| 4. | SE. | strong, | 30.102 | + 35 | 6 | 11.5889 | 11.4733 | 11.5311 | 1118.10 |

Omitting the last of these results on account of the strong wind, the mean of the other nine give a velocity of 1035.19 feet, at the temperature of — 17.72 F. Substituting this temperature in the formula given above, and omitting P because $f$ is wanting or unknown, we obtain a velocity of 1001.92 feet, which comes short of experiment by 33.27 feet; a difference which can never be owing to errors of observation, but more likely to the great intensity of sound in air condensed by cold.

Lieutenant E. N. Kendall, who accompanied Captain Franklin in his second journey to the shores of the Polar Sea, made numerous experiments on sound at Fort Franklin, by means of muskets. The ranges were from 1521 to 6084 feet; and, generally, shots were fired at both ends of the base, with the view of obviating the effects of wind. The following Table contains the results of about forty observations. The thermometer was the only meteorological instrument employed at the time.

| 1825. | Temperature, Fahrenheit. | Mean. | Velocity, Feet. |
|---|---|---|---|
| October 31, | From + 28° to + 27° | + 27°.5 | 1112 |
| Nov. 3, | + 10 + 3 | + 6.5 | 1089 |
| 14, | — 2 — 4 | — 3 | 1079 |
| Dec. 23, | — 36 — 35.5 | — 35.7 | 1036.1 |
| 24, | — 41 | — 41 | 1030.3 |

The mean of the Table gives a velocity of 1069.28 feet, at the temperature of —9° 14′; but this temperature being substituted in the formula gives only 1011.83 feet, which is too small by 57.45 feet.

In the Philosophical Magazine for June 1824, may be seen a very particular account of a vast number of experiments made with great care by Dr Gregory, in the vicinity of Woolwich, and which give just as little countenance to theory as those mentioned above. To these, Dr Gregory has annexed an abstract of Mr Goldingham's experiments, which were made at comparatively high temperatures in the torrid zone. They deviate in all manner of ways from theory.

HENRY MEIKLE.

## *Examination of the Experiments hitherto published on Subterranean Temperature, together with Experiments and Inquiries relative to this Examination.* By M. L. CORDIER, Member of the Royal Academy of Sciences, and Professor of Geology in the Garden of Plants. (Concluded from last Volume, p. 291 *.)

THE running waters of mines are much less calculated to afford correct indications than the springs and filtrations. They commonly arise from the union of several rills having different origins. According to the local circumstances and the length of their course, they are more or less affected in their temperature, by the contact of the soil over which they have flowed, by the effect of evaporation, or by the influence of the surrounding air. Thus, for example, they may be far above the proper temperature of the level of observation, if they have come frequently into contact with an air much heated by the effect of the season, and at the same time by that of the lights, and the presence of the workmen; and if the walls of the excavations have had time to contract a heat superior to that which they originally possessed. The observations of the kind in question are therefore subjected to too many causes of uncertainty to afford results having any degree of accuracy, with reference to the law which the increase of temperature follows in the bosom of the earth.

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* The reader is requested to correct a typographical error in last volume, page 291, where Temperature of *Puisards*, or engine-pits, is erroneously substituted for Temperature of *Springs*.

Let us now examine the three cases which we have distinguished with relation to the stagnant waters.

1st, The small pools that are met with in mines, it is evident, can only give very defective indications, for these indications may vary according to the following causes, viz. the original temperature of the water; that of the rock, if it has been modified; that of the air; and the influence of evaporation. It may besides be conceived, that, however shallow the pool may be, the temperature of the surface may be higher than that of the bottom. I shall adduce two examples to illustrate these considerations.

At Carmeaux, in the Ravin mine, where, on the 9th November 1822, I found the proper temperature of the rock at 62°.8 Fahr.; and where the air marked near the bottom of the galleries, from 70°.7 to 71°.6 Fahr.; and near the roof, from 73°.4 to 74°.1; I noted from 65°.5 to 67°.1 in very small pools.

At Littry, in a gallery at the bottom of which I found the proper temperature of the rock 61°.043, the air marking 70°.97 near the roof of the gallery, I found that the temperature of the water of a small waggon-way, 15 inches in depth, rose to 63°.63.

In these two cases, the temperature of the water would have given an erroneous indication of the proper heat of the rock.

We are therefore authorised to reject the employment of almost the whole of the observations of this kind. The numbers that would be deduced from them would be affected with too much uncertainty to be usefully consulted, even as approximative documents, with reference to the object in view.

2. The water of engine-pits commonly possesses a very compound temperature, and which could only represent exactly that of the surrounding rock in very rare cases, resulting from compensations which it would be impossible to appreciate. In fact, this temperature depends upon the original heat of all the rills of water which flow from different levels, upon that of the rock forming the basin, which may have been more or less modified, on the time during which the water has remained in it, and on the influence of the ventilation, which is commonly very active. Further, if an engine-pit have a great depth, such as 150 or even 300 feet, which may take place, the temperature could scarcely be uniform in it in the vertical direction; the water at the bottom would be sensibly colder than that of the surface. From these considerations, and from those which were previously mentioned, we are authorised to believe, that the results of the indications collected in puisards are generally inferior to those which it is our object to obtain. I shall mention an example.

At Decise (at the new shaft) I took the temperature of an engine-pit, which was in communication with a great extent of old works that were inundated, and had been abandoned for a very long time, and from which, for a year back, 4240 cubic feet had been taken in the twenty-four hours. The level of the water was at 434 feet 8 inches from the surface; the thermometer marked 61°.02, a quantity much superior to the mean temperature of the country, but lower by 7°.6 than the proper temperature which the rock ought to have at this level, according to the experiments which I shall relate. The water extracted presented a circumstance which I regard as foreign to the result of the experiment. It disengaged a weak smell of sulphuretted hydrogen, as is generally the case with water that has accumulated in old coal-works.

With the above considerations in view, the following table may be consulted with advantage, as giving a general *vidimus*; it contains the results of twelve observations made in England, Saxony, and Bretagne.

***TABLE of Observations made on the Temperatare of the Water of Puisards or Engine-pits in Mines.***

| Places, Authors, and Dates of Observations. | MINES. | Depth of the Stations. | Temperature of the Puisards. | Mean Temp. of the Country. | Depth corresponding to the increase of 1° Fahr. |
|---|---|---|---|---|---|
| | | *Feet.* | ° | ° | *Feet.* |
| **Cornwall.**<br>Mr Fox,<br>Published in 1822. | Copper Mine of South Huel Towan, . . | 270.0 | 60.1 | 50 | 26.7 |
| | Copper and Tin Mine of Huel Unity Wood, | 516.4 | 64.0 | 50 | 36.9 |
| | Do. of Poldice, . . | 864.5 | 77.1 | 50 | 31.9 |
| | | | 80.1 | 50 | 28.7 |
| | Copper Mine of Gwenap, . . . . . | 900.6 | 75.9 | 50 | 34.8 |
| | | | 80.1 | 50 | 29.9 |
| **Devonshire.**<br>Mr Fox,<br>Published in 1822. | Do. of East Liscomb, . | 492.1 | 64.0 | 50 | 35.2 |
| | Lead Mine of Beeralston, | 720.5 | 66.6 | 50 | 43.4 |
| | Mine of Huel Friendship, | 1020.7 | 64.4 | 50 | 70.9 |
| **Switzerland.**<br>De Saussure,<br>Spring of 1785. | Salt Mine of Bex, . . | 721.8 | 63.3 | 48.2 | 47.8 |
| **Bretagne.**<br>Daubuisson,<br>5th Sept. 1806. | Lead and Silver Mine at Poullaouen, . . | 465.9 | 57.6 | 52.7 | 95.1 |
| | | 492.1 | 56.3 | 52.7 | 136.7 |

According to this table, the depth corresponding to the increase of 1° of heat would be, in round numbers, as follows: By six observations made in four mines of Cornwall, from 37 to 27 feet, mean 32 feet; by three observations made in three mines of Devonshire, from 71 to 35 feet, mean 60 feet; by one observation at Bex, 48 feet; and by two observations at Poullaouen, from 137 to 95 feet, mean 116 feet.

3dly, It cannot be disputed that the waters which remain stagnant in mines under the form of great inundations, or true subterranean lakes, are well adapted to give very approximative indications with reference to the object in view. The observations of this description generally lead to results lower than

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[*] This mean temperature is approximative, and probably a *maximum*. Knowing the places, I have concluded it from the following data: Mean temperature of Zurich, 47°.8, for six years, Escher and Wahlenberg; ditto of Coire, 48°.6, for four years, Salis and Wahlenberg; ditto of Geneva, 49°.3

The other means of my four tables are those which the authors of the experiments have indicated. I shall speak of their merit afterwards.

the proper temperature of the rock situated at the same level, unless the mass of water is of great depth, for then the surface of the fluid might manifest a heat which would belong to a lower level. In all cases, the markings that have been collected make a sufficient approach to accuracy, to render it indispensable to inquire what are the numbers that express the increase of subterranean temperature which may be deduced from them. Of this the following table, containing the results of nine observations made in Brittany, Saxony, and England, apprises us.

*TABLE of Observations made on the Temperature of the Water of great Inundations in Mines.*

| Places, Authors, and Dates of Observations. | MINES. | Depths of Stations. | Temp. of Subter. Lakes. | Mean Temp. of Country. | Depth corresponding to the increase of 1° Fahr. |
|---|---|---|---|---|---|
| | | *Feet.* | ° | ° | *Feet.* |
| **Cornwall.**<br>Mr Fox,<br>Published in 1822. | Copper Mine of North Huel Virgin (inundation very deep), | 234.3 | 60.1 | 50 | 23.2 |
| | Do. of Nangiles (inundation very deep), | 528.2 | 57.9 | 50 | 66.8 |
| | Do. of Gwennap (inundation 420 feet deep), | 600.4 | 60.1 | 50 | 59.4 |
| | Mine of Tintang (inundation nearly drawn off, only 59 feet deep), | 643.1 | 63.5 | 50 | 47.6 |
| | Copper Mine of Huel-Maid (inundation drawing off, not more than 180 feet deep), | 756.6 | 60.1 | 50 | 74.9 |
| | Copper and Tin Mine of Tincroft (inundation drawing off, not more than 59 ft. deep), | 756.6 | 63.0 | 50 | 58.2 |
| | United Mines Tin Mines (inundation 180 feet deep), . . . | 1080.7 | 80.1 | 50 | 35.9 |
| **Saxony.**<br>Dauhuisson,<br>End of winter 1802. | Lead and Silver Mines of Junghohe Birke (inundation 118 feet deep), . . . . | 1044.0 | 63.0 | 46.4 | 62.7 |
| **Brittany.**<br>Daubuisson,<br>5th Sept. 1806. | Do. of Huelgoet (inundation 52 feet deep), | 780.9 | 65.8 | 51.8 | 55.8 |

According to this table, the depth, corresponding to the increase of 1° Fahr. of heat, would be, in round numbers, as follows: By seven observations, made in seven mines of Cornwall, from 75 to 23 feet, mean 52 feet; by one observation in a mine of Saxony, 63 feet; and by one observation at Huelgoet, 56 feet.

The simple comparison of the numerical results of the three preceding tables, will be sufficient to shew the imperfect nature of the means of experiment that have been employed. Thus, for example, the expressions of the increase of heat which have been found in the same mine, present variations whose extent infinitely surpasses that which might be admitted as resulting from anomalies arising from particular circumstances of the rock, or from the little inaccuracies to which observations of this kind are liable. But the approximative consequences which one is authorised to draw from the experiments, taken together, do not the less subsist. Moreover, the inequality of the results in different countries is striking, and appears to me to constitute an entirely new consideration, to which I shall have occasion to revert.

I now come to examine the experiments which have been made by methods more direct than those whose results have jnst been discussed. Their object has been to take the temperature of the rock directly, at each of the levels where they have been made. Their number is not considerable, there being only the following:

1*st*, In two mines of Saxony, those of Beschert Gluck and Alte Hoffnung Gotes, M. de Trebra placed stationary thermometers in galleries, situated at different levels, which were at a distance from works in activity, in which there was little circulation of air, and where people seldom passed with lights. Each thermometer was inclosed in a niche, glazed on the fore part, and, moreover, contained in a glass tube; the ball was immersed in a cavity, wrought directly in the rock. A wooden door covered the glass, and was only opened when the indications were to be observed. The observations were continued for a long time; and in one of the mines they were repeated so often as three times a-day for two years. They were confided to the working master-miners (maitres mineurs de service), and verified from time to time by superior officers. This system is evidently better than those of which we have spoken, but it is not unobjectionable. In mines so old, so frequented, so perfectly aired, as those in question, the temperature of the walls of a gallery which has not ceased to communicate with the rest of the works, has had time to receive great modifications. The mine of Beschert Gluck, for example, has been open for two centuries; at the period when the experiments were made, there were constantly in it nearly 200 workmen and 200 lights during five days in the week, and this state of things had existed for about thirty years. Thus, therefore, although the thermometers were invariable in the different points, at least according to M. de Trebra's assertion, there is very little probability that the experiments precisely indicated the original temperature of the rock at each level of observation. If we consider the great extent of the works, the enormous magnitude of the excavations, the abundance of water, and all the other accessory circumstances, we shall be induced to regard the markings collected as being beneath the original temperature which it is our object to discover. The results are consigned in the table which we shall presently give.

*2d*, In a mine of Cornwall, that called United Mines, the temperature of the rock of two galleries, which were inundated for two days, was taken; and, for this purpose, the thermometer was sunk several inches in the earthy matters forming the floor of these galleries. It is evident that this experiment, mode in a cursory manner, involves several sorts of uncertainty. In all probability, the temperature observed represents the original temperature of the level at which it was made only approximately. Previous to the inundation, the rock had already a temperature compounded in the ratio of all the causes which had acted upon it from the opening of the galleries. After the inundation, the presence of the water necessarily produced some modification, for it is almost impossible that it had arrived with a temperature equal to that of the works which it filled. In support of these considerations, I shall mention the results of the following experiments.

At the Ravin mine, near Carmeaux, in the lower stage of which I have already spoken, at 56 feet from the slope (taille), the thermometer sunk about 8 inches in the humid and beaten rubbish which formed the floor of the gallery, marked 4°.7 more than the temperature proper to that level. Operating in the same manner in more distant parts, I found 5°, and up to 5°6 of difference equally in excess. I should probably have had smaller differences, or even differences of a contrary nature, if, in place of observing in autumn, I had operated at the end of winter, and after continued frosts.

There is, therefore, reason to consider experiments of this kind as very inaccurate. I only adduce the results which are consigned in the following table, as approximations which it may be useful to take into consideration.

*3d*, Lastly, in another mine in Cornwall, that of Dalcoath, a thermometer was kept for eighteen months, sunk to the depth of 3 feet 3 inches in the rock of a gallery. I have not been able to procure the details of this important experiment; but, it is to be presumed, that so zealous an observer as Mr Fox, who instituted it, would have bestowed the necessary pains upon it. At the same time, unless the bottom of a gallery was chosen, and unless the experiment was made, not only at a distance from works in activity, but also from all old works, there will be chances of uncertainty. There is, therefore, no absolute dependence upon the accuracy of the result, although we cannot refuse to admit it as highly approximative. I consign the indication afforded by this experiment in the following table, which contains all that relates to experiments made in the rock of the excavations. This table contains nine results obtained in Saxony and Cornwall.

*TABLE of Observations made on the Temperature of the Rock in Mines.*

| Places, Authors, and Dates of Observations. | MINES. | Depth of the Stations. | Temp. of the Rock. | Mean Temp. of the Country. | Depth corresponding to the increase of 1° of heat. |
|---|---|---|---|---|---|
| | *First kind of Observations.* | | | | |
| | | *Feet.* | ° | ° | *Feet.* |
| SAXONY.<br>De Trebra,<br>1805, 1606, 1807. | Lead and Silver Mine of Beschert Glück, | 590.6<br>853.0 | 52.25<br>59.0 | 46.4<br>46.4 | 101.0<br>67.7 |
| De Trebra,<br>1815. | Do. of Alte Hoffnung-Gotes, . . . . | 235.9<br>551.9<br>879.9<br>1246.4 | 47.75<br>55.06<br>59.0<br>65.75 | 46.4<br>46.4<br>46.4<br>46.4 | 174.7<br>63.7<br>69.8<br>64.4 |
| | *Second kind of Observations.* | | | | |
| CORNWALL.<br>Mr Fox,<br>Published in 1821. | Copper Mine, called The United Mines, | 1141.8<br>1200.8 | 87.44<br>87.98 | 50<br>50 | 30.5<br>31.1 |
| | *Third kind of Observations.* | | | | |
| Do. Do.<br>Published in 1822. | Copper-mine of Dalcoath. | 1381.3 | 75.56 | 50 | 54.0 |

According to this table, the depth, corresponding to the increase of 1° Fahr. of heat, will be in round numbers as follows: By two series of observations made during two years, in two points of the mine of Beschert Glück, from 101 to 68 feet, mean 84 feet; by four series of observations made in 1815, in four points of the mine of Alte Hoffnung Gotes, from 175 to 64 feet, mean 93 feet; by two observations made cursorily in the United Mines, 31 feet; and by a series of observations which lasted 18 months, in a part of the Dolcoath mine, 54 feet.

If we compare these numerical results with those previously obtained, it will be seen that they lead to nearly the same consequences. I shall therefore blend them in the conclusions which are to be deduced from all that I have hitherto stated.

But before resuming these conclusions, I must briefly state several important considerations which may influence the judgment that is to be formed respecting the merit of the experiments which have been discussed.

*First Consideration.*—It is not sufficiently known that thermometers are almost always in some degree deficient in accuracy, even when they come from the best artists. In the first place, from the inadvertence of the manufacturer, the scale may have been placed a little too high or too low. I have an instrument of this kind, in which the zero of the scale was originally 0.3 beneath the freezing point. In the second place, from the effect of very small inequalities in the bore of the tubes, differences of three or four tenths are very common in the progress of two instruments regarded as tolerably good. I have often seen greater variations. Lastly, through a vice inherent in the instrument, in proportion as it becomes old, the mercury keeps higher than it ought to do, to correspond with the indications of the scale, and this elevation, which is attributed to a slow contraction of the bulb, may sometimes exceed a degree.

In making experiments on the subject which at present occupies our attention, the first care of the observers should be to verify the accuracy of the thermometers under these different points of view; and the second to give an account of the verifications. Unfortunately, the latter consideration has been neglected by all observers; so that, although it is to be presumed that the verifications have been made, there is no certainty with respect to them.

*Second Consideration.*—The increase of the subterranean temperature is calculated by comparing the results of experiments made in deep places either with the results obtained at a higher level, or with the mean temperature of the country, which is preferable. In the latter case, the accuracy of the comparison is only perfect when the mean temperature in question is precisely known. Now, with the exception of the experiments of the Paris Observatory, I do not believe that the means which I have employed above, can be depended upon as correct to within half a degree on either side.

*Third Consideration.*—Doubts may be entertained regarding the absolute depth of the points at which most of the observations have been made. It appears probable, that almost all the observers have referred this depth to the plane in which the entrance of the shaft nearest the stations is situated. If they had taken pains to determine, by rigorous operations, the distance comprised between each station and the point of the upper surface of the rock situated in the same vertical line, they would not have failed to mention it. Now, as the shafts are seldom opened on heights, it is to be presumed that most of the depths assigned are too small, and that, consequently, taking this cause alone into consideration, the augmentations of temperature which might be deduced from them would be too great.

The influence of this cause of inaccuracy is so much the less, the deeper the places are in which experiments are made; and this observation is equally applicable to the two other causes which we have examined.

*Fourth Consideration.*—All the statements collected respecting the temperature of fresh water springs, of artificial spouting fountains, of currents of water sufficiently large to turn machinery at their origin, such as the river Isle, near Vaucluse, and the Touve, near Angouleme, concur to prove the increase of subterranean heat. The only exception which I know is, when the springs are overlooked by high mountains, on which a great quantity of snow annually melts. It is to this case of exception that the two following facts refer, which were observed by Saussure, the first in the month of August 1789, the other on the 4th of August 1792 *. A stream of water, capable at its source of turning a mill, and which is situated near Macugnaga, at the bottom of the great snowy amphitheatre of Mount Rosa, marked only 38° 75′ F. by the thermometer. Large springs flowing at the foot of a great limestone chain, about 550 metres above the sea, at the bottom of the valley of the Arve, near Sallenche in Savoy, marked 45° 9′ F.

To these facts I shall add the following, which is more remarkable. The beautiful fountains of Medouze, situated in the High Pyrenees, near Bagneres de Bigorre, at the entrance of the Valley of Campan, and at the very level of the bottom of that celebrated valley, produce a rapid stream of water, which, at its source, turns three mills in a space of 200 yards. On the 22d September 1822, at ten in the morning, I found their temperature 50° 7′; that is to say, about 7° below the mean temperature of the bottom of the valley. The strong current of air which issued with the water was of the same temperature.

Anomalies of this kind are easily explained from local circumstances. No plausible objection can result from them, against the general inference to be drawn from the heat of all the fresh water springs, and all the currents of water coming from the interior of the earth.

*Fifth and Last Consideration.*—Formerly, when mineralogy was limited to the study of some rare and sparkling substances, pyrites were everywhere seen, even in lavas, although these productions were completely destitute of them, and it was imagined that several great phenomena, depending upon the constitution of the earth, could be accounted for by supposing subterranean fermentations produced by the decomposition of these pyrites. These two kinds of prejudices are now properly discredited, at least among those who are acquainted with the full progress of geology. In fact, pyrites are infinitely less abundant than has been supposed, especially in masses of any extent. They are for ever unalterable, so long as they remain enveloped in the rocks which contain them. Placed in the most favourable circumstances, two of the three species of pyrites that have been discovered are permanent, or are only decomposed with extreme difficulty. One species only, radiated pyrites, is capable of being rapidly decomposed; but for this certain circumstances are required, and these circumstances are always the production of art, excepting in some natural cases, so rare and limited, that they may be entirely kept out of sight. Before pyritic masses of this kind are greatly altered, they require to be crumbled naturally, or reduced to fragments; for decomposition acts only in the ratio of the surfaces. It is farther necessary that the cavities which inclose it, or that the rubbish in which it is contained, be not too much or too little moistened, and that the circulation of air be not too active, otherwise the alteration is very slow, and then there is no sensible disengagement of heat. I shall mention a remarkable example illustrative of this subject.

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* Voyages dans les Alpes, sect. 1403 and 226.

The coal mines of St George Lavencas, in the department of the Aveyron, consists of horizontal beds half a yard thick at the most, and which are worked by galleries opening toward the upper part of the declivity, which borders to the west the immense limestone platform of Larzac in which they are situated. The roof and floor of each bed are formed of a bituminous and pyritous schist, which was extensively worked, when the price of copperas and alum was much higher than at present. The slate was allowed in a great measure to effloresce in the mine before it was extracted. I visited these mines long ago, and remarked no extraordinary elevation of temperature in them. I returned on the 5th November 1822. The works extended very far into the body of the mountain, and their dryness was remarkable; the galleries, according to the custom of the country, were only high enough to allow the miner to work on his side, and drag out the carriage loaded with the combustible by creeping. They were very tortuous and frequently contracted. The air circulated very imperfectly, and in a very imperceptible manner. The pyritous slate was every where in decomposition, whether at the surface of the excavations, or amongst the numerous heaps of rubbish. Yet the temperature of the air in the works nowhere exceeded 68°7. Now, it is to be remarked, that the external air was then at 67°6, and that I experimented between two and three in the noon.

In general it is the case, that the circumstances adapted to produce any remarkable degree of heat, by the decomposition of the radiated iron pyrites in mines, are far from being of frequent occurrence, and that when they do occur, it is but rarely that they act on great masses. There is nothing, besides, more easy to discover and determine than effects of this kind; the rock crumbles, and is resolved into earth or gravel; saline efflorescences manifest themselves in great abundance; the waters become strongly vitriolic, and their circulation gives rise to various inconveniences, against which the miner has to provide; *lastly*, in however small a degree a mass of rubbish or broken down rocks happens to assume a temperature superior to that of the surrounding works, there is none of the workmen that does not perceive it.

Thus, for example, when I descended into the mines of Decise on the 1st September 1825, my questions respecting the matter in question, were prevented by pointing out to me a portion of the old works, at a great distance from that in which I made the experiments, of which I have given an account, where the miners wrought stark naked. The cut was in the midst of an old mass of coal, having in its centre a heap of rubbish that had long been heated. To the hand the surface of the cut which had just been laid bare felt warmish. With the thermometer, the interior of the coal marked 80°6, that is to say 14°4 more than the proper heat which the rock should have presented at this level. The air which circulated with difficulty in this small work, indicated 82°4.

I shall conclude what it was necessary to state on this subject, by remarking that part of the observations which we have discussed, were made in excavations where there were no pyrites, or in mines where it existed in so small quantity or was so incapable of decomposition, that it may be overlooked. This remark necessarily applies to the conduits of such diversified nature, in which the waters that filtrate in mines, and even in general those of superficial springs, acquire their temperature. With regard to mines in which there exists pyrites in any considerable quantity, the observers assured themselves that no influence could result from it upon the temperature of the excavations in which they experimented. The character of the observers can leave no doubt on this subject, and their testimony is in harmony with what we have just stated.

We shall now sum up the consequences that may be drawn from the first part of our investigation.

1*st*, If we except a certain number of observations as presenting too much uncertainty, all the rest announce in a more or less positive manner, that there exists a remarkable increase of temperature proceeding from the surface of the earth towards the interior. It was therefore with reason that this increase was admitted.

*2d*, The results obtained at the Observatory of Paris are the only ones from which a numerical expression of the law which this increase follows may be deduced with certainty. This expression carries to 51 feet, the depth which corresponds to the increase of 1° Fahr. of subterranean heat, and, as we cursorily, mention, there results from this that the temperature of boiling water would only be 8212 feet, or one and a-half miles English, under Paris).

*3d*, Of all the other results, only a small number furnish numerical expressions sufficiently approximative of the law in question to be admitted. These expressions vary from 104 to 24 feet for 1° Fahr. of increase; their mean announces in general a more rapid increase than that hitherto admitted. Their testimony has so much the more weight, that they comprise the products of several series of sedentary observations.

4*th*, Lastly, in grouping by countries all the results admissible in whatever degree, I am led to present a new and important idea, which is, that the differences between the results collected in the same place, do not depend solely upon the imperfect nature of the experiments, but also upon a certain irregularity in the distribution of the subterranean heat in different countries.

Thus the observations that have hitherto been published possess a real merit, an effective and incontestible value; but it is also evident that they leave much to be desired in certain respects. In this state of things, as the number is of less importance than the choice and accuracy of the experiments, I trust that those in which I have engaged, and of which I shall give an account, will be useful, were it only as first steps in this important investigation *.

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* We hope to find room for Cordier's own experiments in our next Number.—EDIT.

## *Descriptions of Columellia, Tovaria, and Francoa; with Remarks on their Affinities.* By Mr David Don, Librarian of the Linnean Society, Member of the Imperial Academy Naturæ Curiosorum, of the Royal Botanical Society of Ratisbon, and of the Wernerian Society of Edinburgh, &c. Communicated by the Author.

These genera were established many years ago, but, from the imperfect nature of the descriptions published of them, their affinities have remained hitherto undiscovered, and the real nature and structure of several of their parts of fructification have been either wholly overlooked, or but partially understood. The object of this communication, therefore, is to give complete descriptions, and to point out the distinguishing characteristics of these genera, with a view to determining the stations they severally occupy in the Natural System. In the accomplishment of this object, the extensive collections of the authors of the *Flora Peruviana*, now composing part of the Lambertian Herbarium, have been of essential service, as they contain numerous specimens of *Columellia* and *Tovaria*, two genera first proposed in the above-mentioned work.

It is a just observation, that the ascertaining the true characters and affinities of genera already established, is much more important to the advancement of science, than the addition of new ones, at least where these do not develope any very important modifications of structure. The genus first in order is *Columellia*, of which I shall now proceed to give a detailed description.

*Syst. Linn.* DIANDRIA MONOGYNIA.

*Ord. Nat.* COLUMELLIEÆ, *nobis.*

Columellia, *Ruiz et Pavon.*—Uluxia, *Juss.*

*Calyx* monophyllus, turbinato-tubulatus, adnatus, levitèr ancipiti-compressus: *limbo* persistente, 5-lobo: *laciniis* subæqualibus. *Corolla* summo tubo calycis inserta, rotata, limbo 5-loba, concava: *lobis* æqualibus, rotundatis, integerrimis, æstivatione convoluto-imbricatis, calycinis laciniis alternantibus. *Stamina* 2, corollæ fauci incrassatæ inserta, angulis calycis opposita: *filamenta* brevissima, dilatata, complanata: *antheræ* triplici modo bicrures, replicatæ! (hinc trilobatæ depictæ in *Fl. Peruv. Gen.* t. 1.) *loculus* unicus tantùm, per omnes convolutiones continuatus! angustissimus, cartilagineus, fissurâ longitudinali dehiscens. *Pollen* angulatum, resinosum. *Ova-*

*rium* inferum, biloculare: *ovulis* indefinitis. *Stylus* declinatus, corollâ brevior, compressus, levitèr sulcatus, disco crasso, carnoso impositus. *Stigma* dilatatum, subcapitatum, suprà convexum, obsoletè cruciato-sulcatum. *Capsula* turbinata, lignosa, bilocularis, bivalvis, calycis tubo arctè connata, ejusdemque laciniis cum disco perigyno coronata, apice rimâ cruciatim dehiscens: *loculis* polyspermis: *valvis* apice bifidis. *Dissepimentum* compressioni pedunculi contrarium, crassum, coriaceum, e duplici laminâ solubili capsulæ parietis introflexâ constitutum, lobis margine interiore reflexis, et in utroque loculo pronis, placentiferis, medio hinc solutum. *Semina* adscendentia, obovata, compressa, margine obtuso incrassata, badia: *umbilico* basilari: *testa* simplex, crassa, coriacea, lævissima, apice callositate nitidâ fulvâ notata: *albumen* carnosum, lutescens. *Embryo* erectus, axilis, lacteus: *cotyledones* ovales, obtusæ: *radicula* cylindracea, recta, cotyledonibus longior, infera, centripeta. *Plumula* inconspicua.

Arbores *v.* frutices (Peruviani) *frondosi, sempervirentes.* Folia *opposita, petiolata, integra.* Flores *terminales, brevissimè pedunculati, lutei.* Pedunculi *basi bibracteati.*

**1. C. *oblonga,* foliis oblongis venosis apice dentatis, floribus corymbosis.**

Columellia oblonga, *Ruiz et Pavon, Fl. Peruv.* i. p. 28. t. 8. f. *a.*—*Syst.* i. p. 8.—*Vahl, Enum.* i. p. 300.—*Rœm. et Schult. Syst.* i. p. 270.—*Spreng. Syst.* i. p. 89.

C. arborescens, *Pers. Syn.* i. p. 13.

*Habitat* in Peruviæ sylvis ad Pillao. *Ruiz et Pavon.* ♄. (V. s. in Herb. Lamb.)

*Arbor* habitu *Kalmiæ,* 4-orgyalis et ultrà, ramosissima, frondosa, cortice deciduo. *Ramuli* oppositi, post lapsum foliorum nodosi, sericeo-pubescentes: *internodiis* compressis. *Folia* decussato-opposita, elliptico-oblonga, inæquilatera (latere exteriore majore!) apice tuberculato-dentata, basi attenuata, suprà nuda, viridia, nitidissima, subtùs tenuissimè sericea, indè glauca, costâ prominente venisque obliquè arcuatis, manifestè reticulatis, pollicaria v. bipollicaria. *Petioli* angusti, subtùs carinati, ferè semiunciales. *Corymbus* foliosus, multiflorus. *Pedunculi* calyce breviores. *Segmenta calycina* lanceolata, integerrima, subtùs sericea, apice mucronulo corneo munita. *Corolla* lutea.

**2. C. *obovata,* tomentosa; foliis obovatis mucronulatis integerrimis aveniis, floribus subsolitariis.**

Columellia obovata, *Ruiz et Pavon, Fl. Peruv.* i. p. 28. t. 12. f. *b.*—*Syst.* i. p. 9.—*Vahl, Enum.* i. p. 300.—*Rœm. et Schult. Syst.* i. p. 270.—*Spreng. Syst.* i. p. 89.

C. frutescens, *Pers. Syn.* i. p. 13.

*Habitat* in collibus aridis ad oppidum Tarma Peruvianorum. *Ruiz et Pavon.* ♄. (V. s. in Herb. Lamb.)

*Frutex* facie *Leptospermi,* ramosissimus, 8-pedalis. *Ramuli* nodosi, pube incanâ persistente, demùm nigricante, copiosè vestiti: *internodiis* teretiusculis. *Folia* conferta, decussato-opposita, obovata, mucronulata, integerrima, coriacea, basi attenuata, suprà nuda, lætè viridia, nitidissima, avenia, subtùs copiosè tomentosa, costâ prominente carinata, venis inconspicuis, quartum v. dimidium pollicis longitudine æquantia. *Petioli* basi in annulum vaginantem connati, brevissimi, vix à foliis distincti. *Flores* dispersi, in apice ramulorum solitarii, rarò gemini v. terni, brevissimè pedicellati, minores. *Pedicelli* basi bibracteati. *Calycis laciniæ* ovatæ, obtusæ. *Corolla* lutea, limbo planiusculo.

3. C. *sericea*, foliis oblongis integerrimis subtùs sericeis, pedunculis terminalibus bi- aut trifloris.—*Kunth, in H. et B. Nov. Gen. et Sp. Pl.* ii. p. 388.—*Syn.* ii. p. 139.—*Spreng. Syst.* i. p. 89.

*Habitat* in sylvis provinciæ Quitensis. *Humboldt et Bonpland.* ♄.

*Arbor* triorgyalis: *ramis* oppositis, fragilibus, teretibus; *junioribus* obsoletè tetragonis, sericeo-pubescentibus. *Folia* opposita, brevitèr petiolata, conferta, oblonga, obtusa, brevissimè mucronata, basi in petiolum angustata, integerrima, venosa, coriacea, suprà glabra, viridia et nitida, subtùs albo-sericea, subpollicaria, 5–6 lineas lata. *Pedunculi* terminales, uni- bi- aut triflori pedicellique sericei, bracteati. *Bracteæ* lanceolatæ, sericeæ, pedicello breviores. *Calyx* sericeus. *Corolla* lutea. *Capsula* subpyramidata. *Semina* ovata, complanata.—*Kunth*, in l. c.

*Obs.*—Planta mihi prorsus ignota, et ut ex descriptionum comparatione conjectari licet, species videtur distinctissima. Genus Menodoræ generi valdè affine, cujus genericus character sequens est: *Calyx* ovario adhærens, campanulatus: *limbo* multi- (10–11-) partito, laciniis subulatis. *Corolla* monopetala, tubo brevissimo, fauce intùs villosâ: *limbo* concavo, 5–8-partito, lobis ovatis, acuminatis, æstivatione convolutis. *Stamina* 2, fauci inserta: *filamenta* capillaria, glabra: *antheræ* biloculares, sagittatæ, erectæ, apice mucronulatæ: *loculis* parallelis, rimâ longitudinali dehiscentibus, basi productis in lobis 2, brevissimis, obtusis, subdivaricatis, supernè confluentibus. *Ovarium* inferum, biloculare: *ovulis* indefinitis. *Stylus* declinatus, filiformis, tenuis, glaber, corollâ longior. *Stigma* truncatum, pruinosum. *Capsula* tubo calycis connata, bilocularis, septicido-dehiscens, polysperma. Herba multicaulis, foliis oppositis, integris, floribus solitariis, pedunculatis, flavis.

*Obs.*—Si floralia integumenta Mogorii et Menodoræ comparantur, uti et capsula Columelliæ, Nyctanthis atque Syringæ; si prætereà corollæ æstivatio in Columelliâ et Menodorâ, earundem staminum numerus, ovulorum placentatio, et seminum fabrica atque foliorum situs perpendantur, arctissima eorum cum Jasmineis affinitas faciliùs patebit: sed cum hæcce genera nulli naturali ordini hucusque ab auctoribus instituto aptè adjungi possint, rectiùs visum fuit novum stabilire ordinem *Columellearum* nomine insignitum; qui a Jasmineis distinguitur ovario calyci adhærente; disco perigyno; stigmate indiviso; capsulâ loculis polyspermis.

That *Columellia* and *Menodora* are intimately allied, a comparison of the parts of fructification clearly proves, although they differ somewhat in habit, the one being herbaceous, and the other arborescent. M. Bonpland (*Pl. Æqu.* ii. p. 99.) appears to me to have approached near the truth, when he referred *Menodora* to the *Jasmineæ*; but both he and M. Kunth have overlooked its close affinity to *Columellia*; for the latter has placed *Menodora* in *Acanthaceæ*, and *Columellia* among the *Scrophularinæ*; and Sprengel, in his *Systema Vegetabilium*, has referred this last to *Gesnereæ*. They correspond with the *Jasmineæ* in the structure and æstivation of their corolla, in their bilocular ovarium, and erect ovula; and they agree both with them and *Syringa* in the structure and dehiscence of their capsule. A comparison of the corolla and calyx of *Menodora*

with those species of *Jasminum*, wherein the number of segments is also indeterminate, will display more clearly the intimate affinity existing between these two families. They differ, however, essentially from *Jasmineæ*, by having an adherent ovarium, by the presence of a perigynous disk, by the undivided stigma, and lastly, by having an inferior capsule, with polyspermous cells. The imbricate æstivation of their corolla, an adherent ovarium, with erect ovula, the presence of a perigynous disk, and a capsule with polyspermous cells, are characters sufficiently numerous and important to prevent their being ever confounded with the *Oleinæ*, and to establish them as an osculant group between that family and *Jasmineæ*, and to which the name of *Columellieæ* may be given. I was at first disposed to regard the singular structure of the anthers in *Columellia*, as arising from the confluence of two stamina; but the uninterrupted continuation of the cell throughout the various convolutions, and an examination of the anthers in *Menodora*, prove these organs in *Columellia* to be only simple. But the *Columellieæ* appear to be nearly related also to *Halesia*, which constitutes the rudiments of another small group, forming the connecting link between *Oleinæ* and *Ebenaceæ*. This group, which I have named *Halesiaceæ*, and which is widely different from *Styracinæ*, are principally distinguished from *Columellieæ* by the indefinite number of their stamina, and their simple stigma.

## TOVARIA, *Ruiz et Pavon.*

### *Syst. Linn.* OCTANDRIA MONOGYNIA.—*Nat. Ord.* CAPPARIDEÆ.

*Calyx* plerumque 8-phyllus (rariùs 6, 7, v. 9-phyllus), patens, deciduus: *foliolis* ovato-lanceolatis. *Petala* foliolis calycinis numero æqualia, et alterna, disco elevato, carnoso, tuberculato inserta, obovata, 5-nervia, venis distinctis: *unguibus* densè papilloso barbatis. *Stamina* tot quot petala, iisdemque alterna, et disco magis ad interiùs inserta: *filamenta* subulata, infernè pilis simplicibus copiosè ornata: *antheræ* introrsæ, biloculares, basi insertæ, primùm erectæ, demùm maturescentes incumbentes, et sæpè quasi extrorsæ: *loculis* parallelis, basibus solutis, rimâ longitudinali dehiscentibus: *valvulis* crassiusculis. *Ovarium* uniloculare, læve, sphæricum, disco impositum: *ovulis* plurimis, parietalibus. *Stylus* brevissimus, crassus, teres, glaber. *Stigma* 8-lobum, lobis tuberculiformibus, primùm conniventibus, subtùs sulcatis, hinc cupulatum, suprà concavum, 6–8-sulcatum, copiosè papilloso-puberum, disco umbilicatum. *Bacca* globosa, unilocularis, crustacea, stylo persistente coronata, disco elevato imposita, intùs pulpâ succulentâ omninò repleta, nervis stigmatis lobis numero æqualibus peragrata, irregularitèr rumpens, polysperma. *Semina* numerosissima, simplici gyro cochleata, in pulpam nidulantia: *testa* duplex; *exterior* crustacea, badia, minutè punctata; *interior* membranacea, diaphana, alba, cellu-

laris, apice chalazâ minutâ, fuscâ, prominulâ notata: *albumen* nullum. *Embryo* curvatus, semini conformis, luteus: *cotyledones* semicylindricæ, obtusæ: *radiculâ* his paulò longiore crassioreque, tereti, obtusissimâ, vagâ, umbilico lateralitèr approximatâ.

Herba (Peruviana) *annua, virens, glaber.* Caulis *biulnaris, erectus, ramosus, teres, lævis.* Folia *alterna, petiolata, exstipulata, ternata:* foliolis *lanceolatis, acuminatis, integerrimis, basi attenuatis, subtùs pallidioribus, costâ prominulâ, venis primariis arcuatis, reticulatìm ramosissimis,* 2–4-*uncialibus, pollicem ferè latis;* lateralibus *obliquis;* intermedio *longiore, substipitato.* Petiolus *teretiusculus, suprà levitèr canaliculatus, basi incrassatus; exsiccatione atomis minutissimis resinosis adspersus, uncialis v. biuncialis.* Racemus *terminalis, solitarius, multiflorus, cernuus, spithamæus;* fructiferus *pendulus.* Flores *sparsi pedicellati, penduli, secundi, magnitudine et facie* Pyrolæ unifloræ *subsimiles.* Pedicelli *filiformes, unciales, bracteolâ lanceolatâ, caducâ suffulti.* Petala *alba, calyce longiora.* Bacca *matura magnitudine* Cerasi sylvestris.

1. T. pendula, *Ruiz et Pavon, Fl. Peruv.* iii. p. 73. t. 309.—*Syst.* i. p. 85. —*Gen.* p. 49. t. 8.—*Pavon, in Act. Med. Matr.* i. p. 192.

*Habitat* in Peruviæ nemoribus inter Chinchao et Pati, et in Chacahuassi. *Ruiz et Pavon.* ⊙. Floret Augusto et Septembri. (V. s. in Herb. Lamb.)

*Obs.*—Genus facilè inter Capparideas locandum; accedit Morisoniæ et Cratævæ fructûs formâ et structurâ; Cleomi verò facie, atque foliis compositis; stigmate lobato Papaveraceis analogum; semina omninò ut in Resedâ, quæ, ut mihi videtur, meliùs Capparideis associanda. Resedæ genericum characterem hic subjungere placet:—*Calyx* est 5–6-phyllus, persistens. *Petala* totidem, iisdemque alterna, basi disco cucullato-orbiculari (ut filamentis etiam accidit) margine fimbriato aucta, gynobasi elevatæ inserta: *laminâ* cuneatâ, trifidâ v. tripartitâ, nunc raró (in R. *odoratâ*) 11-partitâ: *laciniis* (in R. *albâ*) linearibus, obtusis, æqualibus, vel (in R. *odoratâ*) teretiusculis, apice clavatis, inæqualibus! aut (in R. *phyteumâ*) lateralibus acinaciformibus, intermediâ dissimili, filiformi, rectâ, nunc antheriferâ! *Stamina*, ut viduntur, definita (2 v. 3 pro uniquoque petalo!) aut (in R. *albâ*) 12 v. 18 (in R. *phyteumâ*): *filamenta* teretia, glabra, apice mucronata, infernè in tubulum, cujus apex ad latus superius in discum papillosum, margine laciniatum, ferè petaloideum (in R. *phyteumâ* maximum) dilatatus, connata: *antheræ* biloculares, primò erectæ, demùm incumbentes, nunc quasi extrorsæ! *loculis* parallelis, bivalvis, basi solutis, cæterùm connatis, suturâ longitudinali dehiscentibus; *valvulâ exteriore* majore! *Ovarium* trigonum v. tetragonum, pedicellatum, uniloculare, pedicello basi filamentorum connatâ arctè munito, apice clausum (ut in R. *phyteumâ*) vel (in *R. albâ* et *odoratâ*) semper foramine apertum: *ovulis* confertis, duplici ordine suturis angulos capsulæ constituentibus, et stigmatibus alternis, insertis. *Stylus* nullus. *Stigma* 3- v. 4-lobum (rectiùs pistilla totidem conferruminata): *lobis* angulis ovarii alternantibus et numero æqualibus, crassis, cruciatìm patulis, complicatis, quasi bivalvis, valvulis conniventibus, apice dilatato-truncatis, papilloso-hispidulis. *Capsula* trigona v. tetragona, membranacea, intùs vacua, nervis stigmatis lobis numero æqualibus, iisdemque perpendicularibus rectis, utrinque ramosissimis, et cum suturis seminiferis reticulatìm connexis! *Semina* simplici gyro cochleata, sessilia, pendula, alba v. lutescentia, duplici ordine alternatìm, et abortu sparsè digesta, umbilico parvo, obliquo, lateri superiori sinûs radiculæ approximato: *testa exterior* crassiuscula, crustacea, punctis minutissimis in lineis elevatis copiosè ornata; *interior* membranacea, diaphana: *albumen* nullum. *Embryo* curvatus, cavitati seminis conformis, teres, lutescens, basin versus parùm angustior: *cotyledones* semicylindricæ, contrariè applicatæ: *radicula* superior, cylindracea, crassa, basi obtusissima, cotyledonibus æqualis, umbilico opposita.

*Obs.*—Stigma complicatum etiam obtinet Delphinium, cujus antheræ, filamenta basi valdè dilatata, ovarii structura, atque seminum placentatio cum iis quæ in Resedâ descripsimus comparata, Resedacearum et Ranunculacearum analogiam commonstrant. Capparideis etiam affinis est *Tropæoleæ* ordo,

cui calyce petalis unguiculatis inæqualibus seminibusque ex albuminosis huic similis; indè vero cruciferis monospermis, ovulis solitariis, seminum fabricâ, foliis alternis exstipulatis, et herbæ sapore.

The preceding description of *Tovaria* accords so well with the leading characters of *Capparideæ*, that the propriety of placing it in that family, must be generally admitted, and an interesting addition it proves, as it points out several analogies and affinities between *Capparideæ* and the neighbouring orders, not before indicated. It must be placed near to *Cratæva* and *Morisonia*, to both of which it approximates in the structure of its fruit; but in habit it comes nearer to *Cleome*, and the structure of its stigma shews at least an analogy, if not an affinity, to the *Papaveraceæ*. In the form and structure of its seeds, it accords precisely with *Reseda*, which I am still inclined to think with M. de Jussieu might be, without much violence to natural affinities, again referred to *Capparideæ*. The *Capparideæ*, *Resedaceæ*, *Cruciferæ*, *Papaveraceæ*, and *Tropæoleæ*, appear to constitute a grand natural class; and near to them, but at different points, must be arranged the *Ranunculaceæ*, *Polygaleæ*, and *Balsamineæ*,—an arrangement which the many analogies and affinities existing between these families appear to justify.

### FRANCOA, *Cav.*

*Syst. Linn.* OCTANDRIA MONOGYNIA —*Ord. Nat.* GALACINÆ, *nobis.*

*Calyx* 4-partitus, persistens. *Petala* 4, calycinis segmentis alterna, spathulata, decidua: *nervis* basi connatis, supernè diffusè pinnatìmque ramosissimis. *Stamina* 16; 8 fertilia, longiora, filamentis subulatis v. setaceis, apice acuminatis; *alterna* castrata, complanata, obtusa, breviora et latiora. *Antheræ* cordatæ, biloculares, basi bilobæ: *loculis* apice confluentibus, suturâ marginali dehiscentibus. *Pollen* farinaceum. *Ovarium* obtusè tetragonum, 4-loculare, sulcis quatuor septis oppositis exaratum: *ovulis* numerosissimis, adscendentibus. *Stylus* brevissimus v. nullus. *Stigma* 4-lobum: *lobis* crassis, dilatatis, obtusis, pruinosis, septis oppositis. *Capsula* tetragona, angulis apice paululùm productis, 4-tuberculata, 4-locularis, 4-valvis: *loculis* prominentibus, suturâ longitudinali dehiscentibus, polyspermis: *valvis* medio septiferis. *Dissepimenta* è duplici laminâ constituta, crustaceo-membranacea. *Columella* nulla. *Semina* angulo loculorum interiori inserta, obovato-oblonga, fuscescentia, lævia, mutica; *matura* nondùm vidi.

Herbæ (Chilenses) *perennes*, *hirsutæ:* pilis *simplicibus*, *deciduis*. Folia *lyrata*, *ferè* Rapi, *reticulatìm venosa:* lobis *rotundatis*, *dentatis;* terminali *maximo*, *cordato*, *obtuso*, *sinuato-dentato:* dentibus *glandulâ terminatis*. Flores *terminales*, *copiosi*, *spicatìm racemosi*. Pedicelli *uniflori*, *basi bracteolâ lancolatâ*, *ipsis longiore suffulti*.

1. F. *appendiculata,* acaulis; foliis petiolatis, racemo laxo secundo, laciniis calycinis lanceolatis acutis, stigmate lobis ovalibus.

Francoa appendiculata, *Cav. in Ann. Sc. Nat. Matr.* iv. p. 237.—*Icon.* vi. p. 76. t. 596.

*Habitat* in insulâ San Carlos de Chiloe. *Ludovicus Née.* ♃.

*Herba* acaulis, hirsuta. *Scapus* subsimplex, teres, pedalis et ultrà. *Folia* petiolata, lyrata, 4-pollicaria. *Racemus* laxus, secundus. *Petala* dilutè roseâ, maculâ saturatiore prope unguem notata. *Filamenta* subulata, alternis sterilibus triplò longiora.

*Obs.*—Clariss. Cavanilles, in tabulâ suprà citatâ, petala ut acuminata depicta.

2. F. *sonchifolia,* caulescens; foliis sessilibus, racemo laxo nutante, laciniis calycinis lanceolatis acuminatis trinerviis, stigmate lobis orbiculatis.

Francoa sonchifolia, *Cav. Icon.* l. c. (in *Obs.*)
Panke sonchifolia, *Willd. Sp. Pl.* ii. p. 487.

*Hab.* in Chili. *Feuillée, Eschscholtz.* ♃. (V. s. in Herb. Lamb. ab Eschscholtzio communicatum).

*Herba* caulescens, tripedalis, hirsuta. *Folia* sessilia, lyrata, utrinque villosa, nunc demùm denudata, 5-pollicaria v. pedalia. *Racemus* laxus, apice nutans. *Flores* secundi, cernui. *Calyx* copiosè villosus. *Petala* spathulata, retusa, lilacina, maculâ oblongâ violaceâ prope unguem notata. *Filamenta* subulata, alternis sterilibus gracilioribus vix ter longiora. *Stigma* 4-lobùm: *lobis* orbiculatis, crassis, disco pruinosis, margine revolutis, primùm conniventibus.

3. F. *ramosa,* caulescens; foliis petiolatis, racemo spicato erecto, laciniis calycinis lanceolatis obtusis enerviis, stigmate lobis cuneatis.

*Hab.* in Chili ad Santiago urbem. *Caldcleugh.* ♃. (V. s. in Herb. Lamb.)

*Caulis* tripedalis, erectus, ramosus, teres, hirsutus, ad basin digitum minorem crassitie ferè æquans, foliis minoribus, petiolatis simplicibus, profundiùs dentatis, hirsutis ornatus. *Folia radicalia* nondùm vidi. *Racemi* erecti, spicati. *Flores* minores et copiosiores, erecti, undique versi. *Petala* obovata, obtusa. *Filamenta* setacea, alternis sterilibus complanatis obtusis quadruplò longiora. *Stylus* distinctus, at brevissimus. *Stigma* 4-lobum: *lobis* cuneatis, emarginatis v. bilobis, crassis, margine revolutis.

*Obs.*—Panke tinctoria *Molinæ* genere omninò diversa videtur.

The imperfect descriptions already given of *Francoa* have given rise to much difference of opinion regarding its relative affinities; and from this cause equal difficulties have attended a knowledge of its species. The genus seems to me to be widely different from all the families to which it has hitherto been referred, and to approximate most near to *Galax,* with which it agrees in almost every particular: the seeds, however, must be excepted, as their structure is as yet unknown. They both agree in the structure of their calyx, which is persistent, the form and nervation of the petals, which are five

in *Galax*, and six in *Francoa*, and alternating in both genera with the segments of the calyx. Both genera likewise correspond in having barren filaments alternating with the fertile ones: but in *Galax* they are united together in a tube, and the anthers consist of a single cell, opening by a horizontal suture. The capsule of both is composed of several loculaments, with septiferous valves, and opening in the middle by means of a longitudinal fissure. The cells unite at the centre, which is destitute of a columella, the seeds, which are numerous and minute, being áttached to the inner angle of each cell. The cells are four in *Francoa*, and most commonly three, although sometimes also four in *Galax*. The stigma, which in both is really compound, in the former is 4-lobed, with a perfectly distinct base, while in the latter it is undivided, with connate lobes, their presence being indicated by the furrows, which correspond in number with the cells of the ovarium. The texture of the leaves, their nervation, and the 'presence of glands terminating the teeth, the leafless stalks, the spiked inflorescence, with single-flowered pedicels, each being furnished at the base with a small persistent bractea, are additional evidence of the intimate affinity existing between these two genera. This small family, which I have named *Galacinæ*, may be characterized as follows:

## GALACINÆ.

*Calyx* 4–5-partitus, persistens. *Petala* 4–5, hypogyna, calycinis segmentis alterna, caduca. *Stamina* 10 v. 16, hypogyna, in tubum apice 10-dentatum connata, aut distincta: *filamentis dentibusve alternis* tantùm antheriferis. *Ovarium* (è tribus v. quatuor folliculis compositum) 3–4-loculare: *ovulis* indefinitis. *Stigma* (è 3–4, compositum) indivisum v. 4-lobum. *Capsula* 3–4-locularis, 3–4-valvis: *valvis* medio septiferis. *Placenta centralis* nulla. *Semina* numerosa, minuta, scobiformia, angulo interiori loculorum inserta; *testa exterior* laxa, membranacea, cellularis; *interior* tenuissima, albumini arctè adhærens: *albumen* copiosum, carnosum. *Embryo* erectus, teres: *cotyledones* brevissimæ: *radicula* longa, cylindracea, centripeta.

Herbæ (Americanæ) *perennes.* Folia *radicalia, simplicia v. lyrata, pinnatifida, serrata:* dentibus *glandulâ coronatis.* Flores *terminales, copiosi, spicato-racemosi.* Pedicelli *uniflori, basi bracteolâ persistente suffulti.*

*Obs.*—Filamenta in *Galace* 10, in tubum apice 10-dentatum connata: dentibus alternis brevissimis rotundatis crassiusculis antheriferis; cæteris petalis oppositis, elongatis, spathulatis, nudis: antheræ infra apicem laterique interiori filamentorum insertæ, uniloculares! loculo transverso, rimâ bivalvi horizontali hiantes: stigma (è tribus arctè connatis) trigonum, trisulcum: capsula columellâ destituta: semina utrinque mucronata, omninò *Acisporæ*, De Cand. Familia prope Philadelpheas et Saxifrageas locanda.

## *Remarks on a peculiar kind of Red Snow observed on the Arctic Ices.* By Rev. WILLIAM SCORESBY, F. R. S. L. & E., Member of the French Institute, M. W. S., &c. Communicated by the Author.

IN Captain Parry's "Narrative of an attempt to reach the Pole," there is mention made of a peculiar description of *red snow*, which was occasionally met with during the progress of the expedition. As the nature of the colouring substance which gives the appearance Captain Parry describes to the snow of the Arctic ice, has, I apprehend, been greatly mistaken, I beg to offer the following remarks on the subject, in order to prevent any unnecessary confusion in respect to the natural history of this curious production.

Having myself seen the kind of red snow observed by Captain Ross on the "Crimson Cliffs," and, likewise, both an orange-coloured and a salmon-coloured snow, similar, apparently, to that described by Captain Parry as occurring upon the floating drift ice, I had no hesitation in saying, that the nature of the colouring matter on the fixed ice which I observed, was essentially different from that on the floating ice; the former consisting in the growth of a vegetable, the latter in the deposition of what I concluded to be an animal substance; and that this was an animal substance derived from the sea, and not a vegetable production of the snow, I was led to conclude from different considerations;—because there was a correspondence between the colour of the sea in which the ice was floating, and the tinge of the ice;—because the coloured part of the ice was only about the edges, or on such low flat portions as might reasonably be expected to be washed by the waves, or flooded by means of interior openings in the mass of ice;—and, lastly, because of the smell of the coloured snow, when dissolved and heated.

That some of the sea-water of the Arctic sea has the property of colouring white porous substances immersed in it (such as porous ice or compact snow), I have ascertained, by repeated observations on its effects, especially in the case of an orange tinge. This effect, indeed, may be almost constantly seen whereever the sea has a turbid olive-green colour, and that quality of water is quite common on the coasts of Spitzbergen and Greenland. It is particularly described in the "Account of the Arctic Regions," (vol i. 175–180), and in the "Journal of a Voyage to Greenland in 1822," (at pages 130, 353–357); and its action on the ice is stated to be such, that it tinges the edges of the masses against which it washes with an orange-yellow stain; and, when thrown upon the windward side of detached sheets of ice, by the action of the "lipper," the colouring matter is separated by the snow, and incorporated with it, whilst the excess of water is filtered off. The animal which gives this peculiarity to the sea, and produces this effect on the ice, belongs to the class Radiaires, and seems nearly allied to the Beröe globuleux of Lamarck. It is about the size of a pin's head, transparent, marked with twelve distinct patches or nebulæ of dots, of a brownish colour. These dots, which appear to give the peculiar colour to the sea, are disposed in pairs, four pairs, or sixteen pairs alternately, composing one of the nebula. The number of these animals in the olive-green sea is immense. A cubic foot was calculated to contain about 110,592. When the water containing these animals was heated, it emitted a very strong odour, in some respects resembling the smell of oysters when thrown on hot coals, but more offensive: the smell of the melted orange-coloured snow when heated was similar. From these considerations, the animal nature and marine origin of the colouring matter on the ice were inferred; and, I apprehend, without any risk of mistake.

But, as the peculiar snow observed by Captain Parry, is described under the different appellations of "rose-coloured," "salmon-coloured," and "red snow," none of which corresponds exactly with the orange tinge, which I have most frequently seen, it is evident that, if the origin of the colouring matter be the same, the animal producing it must be of a different kind or species. Salmon-coloured snow, indeed, I have several times observed, under circumstances of situation, &c. exactly similar to the other; and, without hesitation, I ascribed it to the same cause; and an animalcule, capable of producing the rose or red colour, was particularly examined on my last visit to the coast of Greenland in 1823. The following is the description, as extracted from my manuscript journal of the voyage.

"July 10th, latitude 71° 15′, logitude 17° 20′.W.—In this day's sailing we were chiefly in water of a turbid-green colour. Passed several insulated spots, streaks, and patches of reddish-brown water, similar to what I observed on the coast of Iceland last year *. Some of the water being collected, I put a drop under the microscope, for the purpose of ascertaining the nature of the colouring matter, though I had no doubt, from former observations, that it was animal. On examination, it proved to be animalcules, principally of one kind, alive, and in active motion. In form they resembled the thimble used by ladies in sewing, being paraboloidal. The length of the animalcule was about $\frac{1}{2160}$th of an inch, as ascertained by a micrometer glass, under a powerful microscope, and the diameter about $\frac{1}{3260}$th of an inch. The motion of some was direct, but unsteady; and others moved in a small circle, with one extremity of the animalcule in the centre. The general speed of the progressive animalcules was $\frac{1}{210}$th of an inch in a second, or an inch in three minutes and a-half. The number in a *single drop* of water was calculated, by the aid of the micrometer glass, at 12,960, which was probably rather below the truth. Yet, numerous as they were, they had ample room. Their finny fringes, being transparent, could not be discovered. When a drop of the water was examined in the sun, it was most brilliantly speckled with the animalcules; some became luminous and iridescent, like the fire-fly. All were in rapid motion, being disturbed or inconvenienced, perhaps, by the strong action of the sun's rays profusely reflected from the mirror."

Unfortunately no ice was observed immediately within the action of this peculiar water, to enable me to prove its effects in giving colour to the surface. But there can be no doubt, where the animalcules had the property of producing a turbid reddish-brown appearance in the sea, that a corresponding effect would have been produced on the ice, against which it was dashed.

Besides these two peculiar colours of sea-water, I have also observed brown and yellowish-green; the latter having the appearance of an admixture with flowers of sulphur or mustard;

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* Described in the "Journal of a Voyage to Greenland in 1822," p. 353.

so that, by one or other of the kinds observed, or a combination of them, perhaps the different varieties of red-snow described by Captain Parry might have been produced. At all events, when the effect of the coloured water upon the ice in known cases was so analogous to what Captain Parry describes (the particular shade of colour only being different) we have a very strong presumption that the cause was similar. And as the peculiar situation ascribed to the red-snow of Captain Parry was always such (as far as this circumstance is named) as would with every probability occur, if the colouring matter were derived from the sea, and thrown upon the ice by the waves, or admitted upon the surface through interior orifices, there seems no reason whatever to doubt that the colour was entirely of an animal, and not a vegetable nature. For Captain Parry remarks, that the coloured substance was generally turned up in the soft snow by the passage of the sledge-boats; and that, in one case, where it was seen upon floes, *it always occurred near the margin.* And such precisely are the circumstances in which any animal matter suspended in the sea would be likely to be deposited upon the floating ice around.

## *The Mermaid of the Shetland Seas.*

That there exists in our seas a remarkable animal, which has occasionally been seen, and recognized by the name of Mermaid, seems a fact well established. This popular name, however, being connected with many absurd fables, is calculated to excite a sneer, although Illiger, Cuvier, and other naturalists, have in some measure sanctioned it, by adopting *Halicora* (sea-girl) as a generic denomination. In addition to former evidence of the existence of this uncommon marine animal, we may notice a well authenticated instance which occurred a few years ago off the Shetland Islands.

The crew of a fishing-boat, when at the *haaf* or deep-sea fishing, above thirty miles from land, upon drawing in their ling and tusk lines, were not a little surprised to find that they had hooked by the back of the neck, and brought alongside, an animal of a singular aspect. They mustered resolution enough to take it into the boat, and keep it for some time: but, on perceiving its pectoral mammæ, and on seeing it gasp (or "yawn," as they simply style it), certain superstitious fears, as to its being "unlucky" to kill a mermaid, prevailed; and, in an evil moment, they slipped it overboard. On hearing of the circumstance, Sir Arthur Nicolson of Lochend, a most intelligent Shetland proprietor, and a Justice of the Peace in the county, called the men before him, put them upon oath, and took down their description of the animal. The crew consisted of three persons, William and Daniel Manson, and John Henderson, all residing in Cullivoe, parish of North Yell. Sir Arthur bears testimony to the character of these men for honesty and integrity, though, in point of information, they are not superior to the common class of peasantry of the country.

The animal seems to have been a female, the two pectoral mammæ being described as prominent and full. The skin was smooth and slimy; light grey on the back, and pure white on the belly. On the outside of the mammæ were two swimming-paws, terminating in webbed fingers. The eyes were small, and of a blue colour. The mouth was so large, that, when opened wide, it would admit a man's fist. The neck was remarkably short. The body was not measured, but was guessed to be little more than three feet long; and the circumference, where largest, or near the swimming-paws, was estimated at two feet and a half. From the middle the body tapered rapidly towards the tail, where it appeared to be only about four inches in circumference. The tail was horizontal, and of a semicircular shape, or resembling that of a halbert.

It is certainly to be regretted, that the fishermen (as they candidly state) "did not observe what kind of teeth the creature had;" as on these the generic character chiefly depends. But their general description, which it seems unnecessary farther to detail, accords very well with that of the smaller herbivorous cetacea. Some parts of their description, it must be confessed, are very imperfect; and, as might be expected, the honest men fall into some evident inaccuracies. They say, for example, "the animal had no nose, but two holes for blowing through." It doubtless had no nose resembling the human, and the supposed blow-holes must have been the nostrils; for the herbivorous cetacea do not breathe by blow-holes, like the porpesse or the grampus. Again, they say, the animal "had no ears," but that as, when they spoke, it moved three long gristle-like bristles, they concluded that it heard by means of these appendages. This last is a palpable blunder, these being evidently feelers or organs of touch; and as to the animal having no ears, the Shetlanders must be understood as merely meaning that it had no *external* ears, which is the case with these cetacea.

The imperfection of the description given by uneducated fishermen need not be wondered at, when it is considered how very meagre and unsatisfactory, sometimes, are the descriptions of animals published by well educated men, but who have never made zoology their particular study. It should further be remembered, that the men had to attend to their fishing-lines, probably not less than three or four miles in length; that they never expected to be questioned on the subject; that they could not divest themselves of superstitious dread regarding the strange visitor they had unintentionally called from its profound abode; and, of course, laboured under prepossessions, and were apt to see every thing through a false medium. Lastly, it should be considered that they viewed the animal under the physical disadvantage of deficient light. The deep sea lines are always drawn during night; and it is mentioned that it was "about midnight," in the "beginning of July," that the animal was taken. In a clear night at sea, at that period of the year, the light off Shetland is sufficient, not only for all the purposes of unhooking the fish and sorting the lines, but even for reading large print; still it is only twilight, rendered bright, but somewhat flickering and uncertain, by the reflected light from the surface of the ocean.

We may notice that, above forty years ago, as mentioned by the late Mr Charles Stewart, in his *Elements of Natural History*, a specimen of the Lamantine, one of the herbivorous cetacea, occurred in the Frith of Forth; and we may add, that there seems no good reason for supposing that the Syren, another of these small sea-weed eating whales, may not sometimes wander into the Deucaledonian Sea. But it is remarked by Dr Fleming of Flisk, in his excellent *Philosophy of Zoology* (vol. ii. p. 204), that the "herbivorous apodal mammalia, probably consist of many more species than those which have been hitherto described;" and there are two parts of the description given by the fishermen, which, we think, render it highly probable that theirs was a nondescript species. They state, that "on the corner of each shoulder was placed a fin, of a round form, which, when extended, covered both the breasts and the arms."

In regard to this striking fact they could not surely be mistaken. Again, they mention, that "there was between the nostrils a thing that appeared to be a piece of gristle, about nine inches long, and which resembled a thick bristle. There was a similar one on each side of the head, but not quite so long, which the animal had the power of moving backwards and forwards, and could make to meet on the top of the skull." As little on this point could they fall into mistake. It may be safely affirmed, that the structure here described *could not* be invented by the fishermen, supposing them inclined to deceive. It is too natural, and the description too graphic and circumstantial, to be a mere fiction; while, it may be remarked, both the round fin and the long feelers detract from the human resemblance which the Shetlanders were naturally inclined to trace in the animal.

Should another specimen happen to be captured in the Shetland Seas, it is confidently expected that it will not be lost; for we understand that not only are the North Yell fishermen now ashamed of their superstitious fears, but that a bounty has been offered to the first boat's crew who shall bring a similar animal to Sir Arthur Nicolson. We conclude with suggesting, that if such an occurrence should take place on any part of the coast, the specimen should be placed in a barrel of spirits, and sent to Edinburgh. From the able zoologists and comparative anatomists of that city, we would soon procure as accurate an account of the structure, external and internal, of the mermaid of Shetland, as has been given by Sir Stamford Raffles and by Sir Everard Home (Phil. Trans. 1820), of the dugong, or mermaid of Sumatra.

## *On Seeing in Water; How do some Animals See in the Dark: On Seeing at a Distance.*

### 1. *On Seeing in Water.*

Those animals whose eyes are organised for seeing in water, see but indifferently in air. Hence, in those cases where the habits of the animal require it, to see in both *media*, it is provided with two sets of eyes, or with eyes accommodated for seeing in each element. Thus the Gyrinus natator, an insect which generally swims on the surface of water, but half submerged, is provided on each side with two eyes, one pair situated on the crown of the head, for seeing in the air, and another pair under the head, for seeing in the water. It is also probable that the fish named Cobitis anableps, which has in each eye an upper and under cornea of different curvatures, and for each cornea a particular anterior surface of the lens, is capable of seeing in water with the one-half of the eye, and in air with the other half. Thus Sœmmering found in this fish, the semidiameter of the upper cornea $=1.0$; the under $=1.2$; the two curvatures of the upper part of the lens $=0.5$; and the two curvatures of the under of it $=0.2$ Paris lines. It cannot be denied, that, in general, land animals can see under water, and aquatic animals in air; even man sees under water, although the contrary has been maintained. It is not, however, possible, that the same eye is ever so organised as to see equally well in both elements. Land animals always see indifferently in water, and aquatic animals imperfectly in air. The one is long-sighted in water, and the other short-sighted in air. An animal in which the eye is adapted for seeing equally well in air and water, can have but imperfect vision in either. These conclusions are in conformity with what is known of the power of vision in those animals that live partly on the land and partly in the water. The Seal (Phoca) is one of those animals that live in both elements. But the seal has but imperfect vision in the air. Rosenthal, in his memoir on the organs of the senses of seals, says, "We have convinced ourselves by careful observation with living seals, of the species Phoca Grypus of Faber, that the animal is always short-sighted in the air; for when we held before it fish and other bodies, as pieces of wood or stones, it did not distinguish them accurately, until they were brought so near, that the organ of smell could be called into activity. Scoresby remarks, " Whales are observed to discover one another, in clear water, when under the surface, at an amazing distance. When at the surface, however, they do not see far." Scoresby's *Arctic Regions*, vol. i. p. 456. Faber, in his very interesting work on the habits and manners of birds that inhabit high northern latitudes, (p. 298, § 55,) remark that Divers (Colymbus) do not see so well above water as Grebes (Podiceps), but better under water, because it is there they obtain their food.

It also appears, that birds which see well in one element, do not see so well in the other. Faber proposes the question, " Is it the case that divers, when under water, draw their nictitating membrane over the eye, as they do when looking towards the sun, in order to prevent the contact of the water? It would appear, from the observations of Treviranus, from whose excellent work, entitled " Beiträge zur Anatomie und Physiologie der Sinneswerkzeuge des Menschen und der Thiere, von Dr G. R. Treviranus, fol. Bremen, 1828," the observations on vision we are now detailing are principally extracted, that, by drawing the nictitating membrane over the eye, divers, and all other land animals, which seek their food under water, are enabled, not only to prevent the immediate action of the water on the eye, but also to discover their prey. But, as the light loses more of its power on passing through water, than in passing through air, and is still more weakened in its progress through the nictitating membrane, it follows, that, owing to this membrane, vision must be less distinct under water than in the air.

### 2. *How do some animals see in the dark?*

Is there any arrangement in the eye, and what is it, by which animals that see in the dark are enabled to make up for the want of external light? When we consider the metallic lustre of the tapetum, which in many animals occupies a great part of the choroid coat, or even its whole surface; further, its resemblance to a concave mirror, and its relation to the light that penetrates into the interior of the eye, we cannot help considering it as the means employed for this purpose, by its collecting the light, and illuminating, by its reflection, objects lying in the axis of the eye. Prevost objects to this explanation, that there are many animals whose eyes have no tapetum, although they conduct themselves as if they saw in the dark. This is actually the case. The tapetum occurs in carnivora, ruminantia, pachydermata, cetacea, owls, crocodiles, snakes, rays and sharks: it is wanting in man, apes, glires, chiroptera, hedgehogs and moles; in birds, with exception of owls; and in osseous fishes. But the gnawers or glires, bats, the hedgehog and mole, are animals that obtain their food more by night than during the day; and many of them conduct themselves in the deepest darkness, as if they were directed by the sense of sight. But this objection may be obviated, by remarking, that it is probably some other sense than that of vision, which procures for many of these animals sensations of external objects in the dark. We have in favour of this opinion, not only the experiments of Spallanzani on bats, from which it appears that, after these creatures were deprived of the use of their eyes, they conducted themselves as if they still possessed the power of vision, but also the examples of species of that family, in which the eyes are so imperfectly developed, or lie so much concealed behind the outer skin, that it is of little or no use to the animal. The genera that see in the dark, have undoubtedly so irritable a retina, that they can only see during a very feeble light, whereas in those animals whose eyes are organized equally for day light and nocturnal darkness, the retina possesses less irritability. Hence, although these are without a tapetum, it does not follow that this organic part does not afford a mean for seeing during a feeble light.

The tapetum is either spread over the whole choroid, or only over the upper half of it. The first is the case with the cetacea, owls, and with those amphibia and fishes which are provided with this shining envelope; the second occurs in carnivorous and ruminating animals. It is more extended in the ruminating than in the carnivorous tribes. But it always extends so far as to encompass the posterior extremity of the internal ocular axis. All the rays of light from external objects which reach it, are united on it, through the transparent part of the eye, and it again reflects back the whole united rays towards the lens. This latter unites them into a single cone, which has the ocular axis as its axis, and its point is directed outwards. The very convergent rays of this cone become more divergent by their passage from the lens into the aqueous fluid, and from this into air or water. Finally the apex of this cone falls into the point of most distinct vision; for in this point is situated the focus of all the rays, that reach from the interior of the eye to the posterior surface of the lens. The cone is complete when the tapetum is spread over the whole of the choroid; but the upper half of it is wanting, when it occupies only the upper hemisphere of this coat. The tapetum is confined to the upper half of the choroid in all animals, whose residence and manner of life are of such a nature, that the under half of the retina is immediately struck by bright day light, and for this simple reason, because the animal must have been dazzled by the reflection of the bright light from the under half of the latter. It covers the whole posterior portion of the internal eye in the cetacea and owls, many amphibia, rays, and sharks; because these animals live constantly in the water, or in a feebly luminous medium, or have their place of residence in dark corners, or go in quest of food during the night. The experiments and observations of Prevost and Esser, detailed in the numbers of this Journal for October 1826 and January 1827, shew that the reflection of light from the tapetum is the cause of the luminousness of the eyes observed under certain circumstances in the twilight in cats, dogs, sheep, and in general in all animals having a tapetum. But whether or not a phosphoric light sometimes proceeds from the retina or choroid, has not as yet been fully ascertained. There are many examples of a luminousness in the dark having been observed in the human eye, (a case of this kind we noticed, and recorded in a former number of the Journal,) yet it wants the tapetum. Probably, as Treviranus remarks, such cases may be of a pathological nature.

## 3. *On seeing at a distance.*

When we speak of the distance to which vision extends, we can understand, as Treviranus remarks, either the sphere of distinct vision, or of seeing in general. The latter has a much larger semidiameter than the former; and the series for the one is in animals different from that of the other. The extent of distinct vision, as is shewn by Treviranus, is pretty nearly in relation with the distance of the lens from the retina in the axis of the eye. But the power of seeing at a distance, Treviranus remarks, depends, in general, in land animals, on the absolute magnitude of the semidiameter of the external surface of the cornea. The larger this is, the greater is the number of rays that reach from distant objects through the cornea to the interior of the eye, and the more easily are such objects rendered visible. But this applies to land animals only. The cornea has no such value in aquatic animals, in arresting the rays of light, as that the limits of vision can be determined by it. If we arrange land animals and birds according to the measure of their power of seeing in the distance, we obtain the following series:—

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|---|---|
| Horse (Equus Caballus) | 73 |
| Ox (Bos Taurus) | 66 |
| Asiatic Elephant (Elephas asiat.) | 65 |
| Antilope Rupicapra | 64 |
| Lynx (Felis Lynx) | 55 |
| Kangaroo (Didelphis gigantea) | 50 |
| Wolf (Canis Lupus) | 45 |
| Fox (Canis Vulpes) | 38 |
| Man (Homo) | 34 |
| Simia Inuus | 30 |
| Hystrix cristata | 30 |
| Marmot (Marmota alpina) | 28 |
| Brown Bear (Ursus Arctos) | 27 |
| Otter (Lutra vulgaris) | 26 |
| Ursus Lotor | 25 |
| Simia capucina | 24 |
| Beaver (Castor Fiber) | 23 |
| Polecat (Mustela Foina) | 23 |
| Horned Owl (Strix Bubo) | 56 |
| Ostrich (Struthio Camelus) | 50 |
| Golden Eagle (Falco Chrysäetos) | 40 |
| Stork (Ardea Ciconia) | 33 |
| Rough-legged Falcon (F. lagopus) | 32 |
| Buzzard (Falco Buteo) | 28 |
| Night-Heron (Ardea Nycticorax) | 27 |
| Short-eared Owl (Strix brachyotos) | 27 |
| Psittacus Aracanga | 25 |
| Turkey (Meleagris Gallopavo) | 25 |
| Tame Swan (Anas Cygnus) | 23 |
| Ardea stellaris | 22 |
| Carrion Crow (Corvus Corone) | 22 |
| Tarrock (Larus tridactylus) | 20 |
| Green Woodpecker (Picus viridis) | 19 |
| Corvus glandarius | 17 |
| Yellow Oriole (Oriolus Galbula) | 15 |
| Psittacus rufirostris | 11 |
| Virginian Opossum (Didelphis virginiana) | 20 |
| Common Squirrel (Sciurus vulgaris) | 19 |
| Badger (Meles Taxus) | 19 |
| Cavia Cobaya | 18 |
| Water Rat (Mus amphibius) | 14 |
| Hamster (Cricetus vulgaris) | 12 |
| Long-eared Bat (Vespertilio auritus) | 4 |
| Crossbill (Loxia curvirostra) | 9 |

In this table, the larger animals, in general, are those that see farthest. But there are exceptions to this rule. It is worthy of remark, that birds which, in the distinct vision of a point, precede quadrupeds of similar magnitude, are inferior to them in distant vision, and that man agrees with birds in this respect. Thus the great owl (*Strix bubo*) ostrich, and golden eagle, excel in the first point; in the latter are inferior to the ox, elephant, &c. The chamoi and the lynx, and many other animals, have a wider power of vision than man, in which the radius of the sphere of distinct vision is much smaller than in him.

This conclusion is contrary to the generally received opinion on the subject. Birds, and particularly rapacious birds, are considered as having a much greater power of distant vision than most quadrupeds; and many will be disposed to challenge the fact, that the ox possesses this power in an equally high, or even in a higher degree. But when we consider fairly the experience on this subject, we shall find that it is not in opposition to what has just been stated. Mayer found in his experiments on the acuteness of vision, that, in seeing, it depends not only on the illumination of the object, and its distance from the eye, but also on the relation of the object and the eye to the neighbourhood. But it is quite otherwise with birds which look from above downwards or with quadrupeds, whose vision is directed upwards or forwards. No one has measured the great distance at which a far-seeing bird perceives its prey; and indeed it will always be difficult to do this with accuracy. But Treviranus remarks, " I doubt not, if we possessed certain observation on this point, that the greatest distance would not exceed that of a far seeing man.

When, for example, Faber, in proof of the sharpness of sight of birds, remarks, " the high flying eagle or the kite perceive the motions of small animals on the ground; the solan sees a very small fish from a considerable height; and gulls, terns, rapacious gulls (*Lestri*), and petrels, fly from all sides to a particular point, where an object is seen floating on water; he presents us with data which are far from being satisfactory. When, on the contrary, Ross affirms, in his voyage to Baffin's Bay, that he obtained certain data, proving that the power of vision of man over the surface of the sea extended to 150 English miles, it is conceivable that the farthest seeing bird could not exceed this. But experience would seem to shew, that birds, although in general their power of distant vision is not very great, possess a very *sharp sight*, in a greater distance than most quadrupeds. In C. A. Schmid's Blicken in den Haushalt der Natür (Halberstadt, 1826, p. 26 *et seq.*), there are many curious observations illustrative of what we have just said. He says, he threw at a considerable distance from a throstle or mavis (*Turdus musicus*) a few small beetles, of a pale grey colour, which the unassisted human eye could not discover, yet the throstle observed them immediately, and devoured them. The long-tailed titmouse (*Parus caudatus*), flits with great quickness, among the branches of trees, and finds on the very smooth bark its particular food. When we examine the spots where it steps for food, nothing is perceived by the naked eye, although minute insects are visible by means of the magnifying glass. A very tame redbreast (*Sylvia rubecula*) discovered from the height of the branch where it usually sat, at the distance of eighteen feet, small crumbs of bread spread out on the ground, the instant they were thrown down; and this by bending its head to one side, and therefore using only one eye. A quail, at the same distance, discovered, by the use of only one eye, some poppy-seeds.

## *On the supposed Petrifying Quality of the Irawadi.* By Professor Buckland. In a Letter to the Editor.

My Dear Sir,

In the last number of your Journal (September 1828), there appears an extract from Lieutenant Alexander's Travels in the Burman Empire (London, 1827), stating, that, during the late military operations at Prome, the pioneers were ordered to remove a house; and, upon endeavouring to cut down the massive teak pillars on which it was raised, they found that the edges of their hatchets were all turned. On examining into the cause of this, they found that the pillars were petrified throughout, though the house had only been built ten years, and the pillars were under water three months in the year during the monsoon.—Page 34.

This statement is so much at variance with the geological observations made by Mr Crawford and Dr Wallich, during their late voyage on the Irawadi, from Rangoon to Ava, and with the opinions I have expressed in a paper I am at this time printing in the Geological Transactions, on the fossil wood and bones which they found on the borders of this river, that I must request you to submit the following observations to the readers of your Journal.

We are told that the period of the submersion of these massive pillars was altogether but thirty months, and that, in this short time, they were petrified throughout; but it is not mentioned whether they were converted into silex or carbonate of lime. Now, the most remarkable example we know of wood silicified by any existing river, is that of the piles of a Roman bridge built by Trajan over the Danube, below Belgrade, which have become silicified at the surface, but not at the centre, during the lapse of many centuries. One of them was taken up and examined by order of the Emperor of Germany, in the year 1760, and found to be converted to agate to the depth of only half an inch from the surface; the inner parts were slightly petrified, and the central still wood *.

In the more common cases of rapid incrustation by calcareous earth, the wood is simply incased with stony matter, and not penetrated by it throughout, as the pillars at Prome are stated to have been. The supposed rapid petrifaction of these pillars, therefore, is so contrary to all experience, and to theoretical probability, that I cannot but imagine that there must be some mistake in the information given to Lieutenant Alexander upon the subject. Is it not more probable, either that the fossil trees, which are so abundant in this district, were made use of as posts to support the house in question, or that the pioneers, on finding the natural hardness of the pillars of teak, were either impressed by the popular belief of the petrifying powers of the Irawadi, or took advantage of it to escape from their laborious task?

Should these hypotheses be untenable, and the pillars have been converted throughout to stone in ten years, and from this cause have defied the axes of the pioneers, they still exist, and may be appealed to in evidence of the fact; not only so, but the

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* See Kirwan's Geological Essays; Essay iv. p. 139.

teak pillars of all buildings, more than ten years old, that are within the flood-level of the Irawadi, will also be converted into stone. It will be therefore easy to procure from Prome and send to London a portion of such a pillar, which would be decisive of the point at issue; but, as the country abounds in petrified trees, it should be remembered that no specimen will be satisfactory, unless it is taken from a building, the age of which is ascertained; and unless it also bears a form and marks that are unquestionably artificial, and the effect of tools antecedently to the process of petrifaction.

I have mentioned this subject to Dr Wallich, and learn from him, that, when he was at Rangoon with Mr Crawford, they were informed, by a British General Officer, that there was at Prome an elephant-shed, the pillars of which were converted to stone at their base, and which they were advised, on no account, to omit seeing. On arriving at Prome, they visited this shed, accompanied by the other gentlemen of the mission, and found its position to be above the flood-level of the Irawadi; and that not one of its pillars had in any part undergone the smallest change from the natural state of wood.

In this case, therefore, as in that reported by Lieutenant Alexander, it is probable that the officer had received, without suspicion, the current opinion of the natives, the universality of which may be referred to the constant use they make of fossil wood, on account of its hardness and durability, for weights and landing-steps from the river, &c. But the investigations of Mr Crawford and Dr Wallich seem decisive upon the subject; they were fully aware of the popular belief that the soil of the country, as well as the waters of Irawadi, have the property of rapidly converting wood to stone; and, during the whole journey, their attention was awake to every opportunity of verifying or refuting this opinion.

Now, I am informed by Dr Wallich, that the bed of the Irawadi, all the way from Rangoon to Ava, was so thickly set with piles of wood, that had formed the foundations of ancient temples, pagodas and sheds, that once, at least, and sometimes more than once, in every day, they were found to afford a more ready supply of substantial fuel than could be obtained from the shore; in one case, they were taken from water so deep, that the steam-boat lay alongside of them during the operation of their extraction. A very large number of these pillars must, therefore, have been burnt during the voyage; and the greatest part of them had remained many years, and some of them probably hundreds of years, subject to partial or continual submersion in the waters of the Irawadi. Not the slightest trace of petrifaction was observed on any particle of all these pillars; and had it escaped the observation of the botanical professor, its presence (if existing) must have been detected in the fire. This evidence seems, therefore, not only to justify the assertion of Mr Crawford, that the waters of the Irawadi have no such petrifying power as the natives ascribe to them, but also to confirm the opinions I have expressed respecting the pillars of teak that are said to have been petrified throughout in the space of ten years.

To the same popular tradition we may also probably refer the remark of Lieutenant Alexander (p. 28,) that "from the mud of the Irawadi, in any part of its course, from ten to twelve per cent of gold-dust may be washed.

It is strange that Mr Crawford and Dr Wallich, who travelled so many hundred miles on this river, and examined so many of its banks and shoals, should have discovered not the slightest trace of the existence of this mud, from every pound of which they might, by the simple process of washing, have obtained more than an ounce of gold; and still more strange, that the Burmese themselves, who informed Lieutenant Alexander of the circumstance, should not have profited by their known proximity to so accessible a source of treasure *.

Oxford, November 1. 1828.

## *Description of a New Kind of Galvanic Pile, and also of another Galvanic Apparatus in the form of a Trough.* By Mr Kemp. With Plates. (Communicated by the Author.)

The great expence of every form of galvanic apparatus that has hitherto been offered to the scientific world, has, without

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* We believe there is a typographical error in Mr Alexander's book, as to the quantity of gold said to occur in the mud of the Irawadi.—Edit.

# PLATE II.

*Fig. 4.*

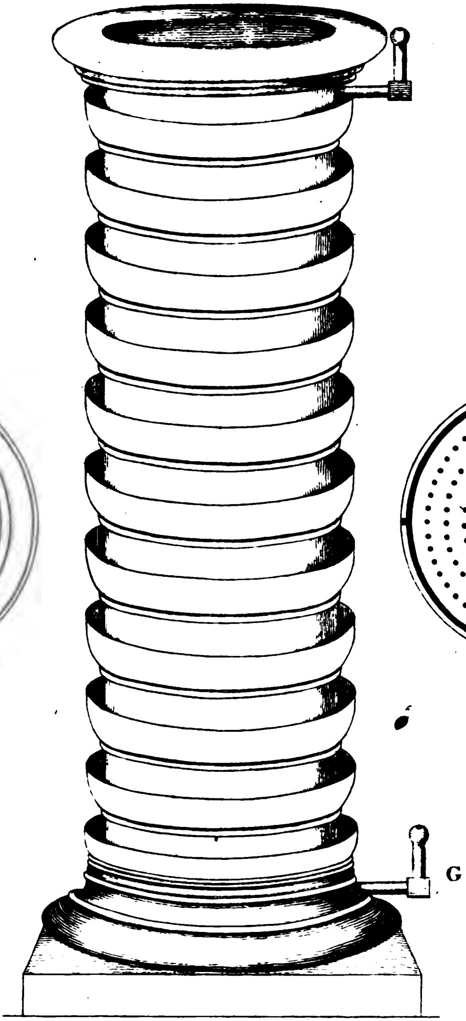


*Fig. 3.*

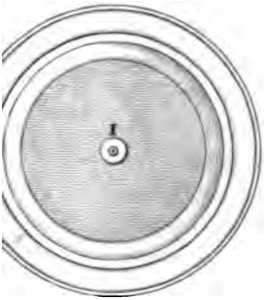


*Fig. 2.*

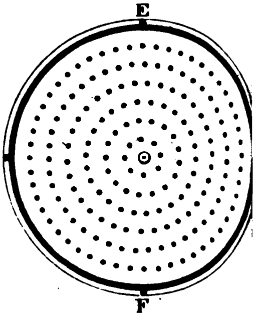


*Fig. 1.*

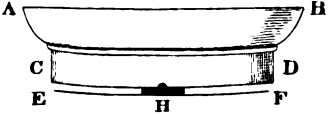
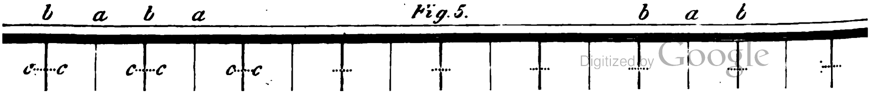


*Fig. 5.*



doubt, prevented, in some measure, the various interesting phenomena which galvanism presents, the laws which govern its action, and its connection with magnetism and electricity, from being more fully investigated.

In performing many of the more important experiments in the science, different sets of batteries are necessary, according as the substances to be acted upon are more or less perfect conductors; and the cost of these batteries being very considerable, few private individuals are possessed of an apparatus sufficiently varied, for investigating the different branches of the subject.

Independently, however, of the expence in procuring the requisite apparatus, another point is to be taken into consideration, and that of the utmost importance, viz. the rapidity with which zinc plates become oxidated, rendering them completely useless for exciting the galvanic fluid, before the batteries are half worn out; and even in conducting experiments where much time is required for observing the results, the quantity of oxide formed on the surface of the zinc plates first retards the action, and finally prevents the motion of the fluid.

A battery, therefore, which might be procured at little expence, (the principal material being in the possession of every chemist), where little or almost no oxide is formed on the surface of the metal, and where the action is much more continuous, would be a very great desideratum, to supply which is the intention of the following paper.

It had frequently occurred to me that mercury might be used as one of the metals for forming galvanic apparatus; and, from the difficulty with which it is acted upon by most of the acids, would answer the purpose of a negative metal better than any other, gold and platinum excepted; unless, indeed, its fluidity destroyed the capability it otherwise possessed for exciting galvanic energy.

After several attempts to obviate this seeming difficulty, I at last succeeded in producing the following apparatus:

AB, CD, Fig. 1. Plate II. represents a circular wooden cup, about half an inch deep, and about three inches in diameter, having a projecting rim AB. EF is a circular convex plate of zinc, attached to the cup, and about an eighth of an inch from it, by a wire either of copper or zinc, the extremity of which passes through, and projects within, the bottom of the cup, about the one-eighth of an inch; the whole is then rendered water-tight by a coating of wax, care being taken to keep the projecting point of the wire quite free from wax.

A quantity of mercury, merely sufficient to cover the bottom, is poured into the cup, which is in contact with the zinc plate EF, through the medium of the wire. Over this is poured as much diluted muriatic acid as will nearly fill the cup. In this manner we have obtained one complete plate, consisting of zinc, mercury and acid; and, by a continuation of the series, they may be increased to any extent.

In erecting this pile, after the mercury and acid have been poured into the cups as stated, they are to be placed above each other, as appears in Fig. 4. Plate II.; the zinc plate of the one will then be in contact with the acid contained in that immediately under it; the cup itself resting on a small check cut round the lower part of the rim. In this manner, any number of plates may be arranged, and, if requisite, kept in their proper places by means of glass-rods inserted into the base. This, however, is only necessary when the pile is of small diameter; for, in one of a larger diameter, a sufficient number may be raised, or they can be arranged in two or more columns, and connected as in the common pile.

For the purpose of experimenting with this apparatus, a small brass socket G passes into the base, and communicates with the mercury in the undermost cup; into this socket a hole is drilled for inserting the wire. Another is attached to the capital or uppermost plate of the pile, from which a wire can be brought to complete the circuit, and varied according as the experiment requires.

The zinc plate is made convex, in order to allow the hydrogen formed at its under surface to escape, which would otherwise collect into a globule, and displace the acid; the use of the projecting edge on the cups is to prevent the running over, and forming a communication between the different parts of the pile, and destroying its action.

In this arrangement, as the zinc is the metal acted upon by the acid, it very soon becomes corroded, and, in this respect, is liable to the same objections as the ordinary galvanic apparatus.

And in a battery where the negative metal is liquid, and the positive solid, no increase of power is obtained over the ordinary apparatus,—a circumstance which would seem to indicate that the negative liquid metal acts merely the part of a conductor; nor can it, while the positive remains solid, transmit the full effect of larger batteries, but must necessarily reduce it in the same proportion as a solid pile; the effect, however, would be very different, were the positive plate liquid, and the negative solid. This I have endeavoured to accomplish by the following arrangement, in which the positive plate is an amalgam of mercury and zinc.

The form of it is the same as that of the pile already described, with this material difference, that, instead of pure mercury, copper is used as the negative plate, and instead of zinc, an amalgam of zinc and mercury as the positive one; and whether we take into consideration the new field it opens up for tracing the laws which govern galvanic action,—its powerful effects on the magnet, and in the combustion of the metals,—or the rapidity with which it decomposes imperfect conductors, must be acknowledged to be of some importance.

AB, CD, Fig. 1. Plate II. represents a circular wooden cup half an inch in depth, and three in diameter, having a projecting rim AB. H is a small button of wood turned on the bottom of the cup at its centre, and which projects one-eighth of an inch from it. EF is a circular plate of copper attached to the cup, by means of a wire of the same metal, on which a screw is formed. The wire passes through the cup, and screws into a brass nut I, Fig. 3., which is sunk into the inside of it; the copper plate being kept at its proper distance by the button of wood. The whole is rendered tight by a coating of wax, care being taken to keep the nut and the projecting point of the wire free from wax.

The copper plate EF, Fig. 2. is perforated with holes, to allow the hydrogen, as it is formed at the surface of the zinc and mercury, to pass up through it and escape, which would otherwise collect into a globule at its under surface, and force the water over the edge of the cups, and destroy the action of the pile. A plate of wire-gauze, or a copper wire coiled round so as to form a plate, will answer the purpose equally well, as it allows the hydrogen to pass freely through its interstices, at the same time that it presents a favourable surface for conducting the fluid.

A quantity of the liquid amalgam of zinc and mercury, merely sufficient to cover the bottom, is to be poured into the cup, which will be in contact with the copper plate EF, through the medium of the nut and wire; over this is poured as much diluted muriatic acid as will nearly fill the cup. In this manner we have obtained one complete plate, consisting of copper, the amalgam of mercury and zinc, and acid, and, by continuing the series, they may be increased to any extent.

In this arrangement, the amalgam of zinc and mercury becomes the positive plate, while the copper is rendered negative.

For the purpose of experimenting with this apparatus, the amalgam of mercury and zinc having been poured into the cups as stated, they are to be placed above each other as appears in Fig. 4.; the undermost plate of which becomes the negative pole, and the uppermost the positive. The circuit is formed the same as in the pile already described.

The formation of the amalgam of mercury and zinc, which is used as the positive plate in this arrangement, is easily effected, and the preparation only occupies a few minutes. A quantity of zinc in fragments being put into a crucible, over which is poured about four or five times its weight of mercury, and heat applied to it by a common fire, when the mercury arrives at its boiling point, the zinc will be found to be completely dissolved. To this composition, while warm, any quantity of mercury may be added, which will combine with it, in the same manner as if it had been heated along with it in the crucible.

The amalgam, when once prepared, is fit for use as long as any of the zinc remains in the solution; and as the quantity dissolved at each time by the acid is very small, the same amalgam may be employed for a considerable time: and, indeed, so long as a particle of zinc remains in combination with the mercury. When the whole is dissolved, the mercury is left in a perfectly pure state, without any diminution having taken place, for the zinc alone is acted upon; and when this is the case, the former process has only to be repeated.

The amalgam, when once made, may be kept, for any length of time, in vessels excluded from the action of the atmosphere, and may be poured from thence in one moment, when wanted, into cups of the requisite size.

Without at present entering into detail regarding the laws which govern the action of this pile, farther than that they appear to be very different from any other, which seems to depend upon the positive plate being liquid, I shall merely notice the following experiments, which were performed by means of a pile, consisting of twelve cups one inch and a-half in diameter.

Having poured into each of them as much of the amalgam of mercury and zinc as covered the bottom, and added the muriatic acid and water, (the proportions being ten parts of water, one of acid, and two of the muriate of soda, these may, however, be varied), I placed them above each other, as shewn in Fig. 4.; the copper-plate of the one being in contact with the acid of that immediately under, through the medium of the wire.

I may here notice an important fact connected with this pile,—that in this state the cups may remain for any length of time ready for experimenting with, without almost any decrease of galvanic energy. This certainly is a decided superiority over any other form of galvanic apparatus, for it is well known, that it is only at the first instant, after being charged, that batteries produce their full effect; at every succeeding instant it becomes less; and in a short time it entirely ceases. This seems to depend upon the particles of zinc, which, having perfect freedom of motion in the mercury, are attracted by the copper-plate with which they are in contact, through the medium of the wire; and, by this means, the mercury is alone exposed to the acid, which has no action upon it. But, upon the destruction of the electrical tension, by completing the circuit, the particles of zinc are no longer attracted by the copper-plate, and, having perfect freedom of motion in the mercury, rise to the surface, are acted upon by the acid, and have again a tendency to restore the pile to its former state of tension. It will thus be perceived, that the action going on in the pile, and, consequently, the quantity of electricity evolved, is in exact proportion to the conducting power of the substance employed to complete the circuit; and this fact is still farther illustrated by the experiments.

In the first experiment, I completed the circuit by two small platina wires; and immersing them in a glass containing pure water, a slow action immediately took place in the body of the pile, and the water was decomposed, the hydrogen appearing at the negative, and the oxygen at the positive wire. I then added to the water a quantity of sulphate of soda, to increase its conducting power. A more rapid action immediately took place in the pile, and a proportionately increased decomposition was effected in the solution.

When a leaf of silver is employed to complete the circuit, by means of a wire and plate of zinc, a combustion of a continuous nature takes place, and also a more rapid action goes on in the pile.

The combustion of the metals by this pile seems to be totally different from that produced by solid batteries; for the more the zinc plate is brought into contact with the leaf of silver, the greater is the generation of electricity in the pile; and consequently the more rapid the combustion. In the solid pile, the quantity of electricity seems to be generated in a progressive manner; and it is only at the moment of contact that combustion takes place, (at least when the plates are small), some time being always necessary to recover its electric state.

If a very perfect conductor, such as a metallic wire, be made to form the circuit, the generation of the electricity in the pile is astonishingly increased. These experiments all tend to prove, that the action in the pile is exactly proportionate to the conducting power of the substance employed to form the circuit.

The electro-magnetic phenomena which it presents are no less interesting. Having rendered a common sewing needle magnetic, and suspended it by a single fibre of silk, I brought the connecting wire over it, at the distance of an inch and a-half, and the energy was of sufficient intensity to cause it to stand at right angles to its natural position; nor was the effect much decreased when, instead of twelve, I only used two of the cups.

The same effect could not be produced by a battery of sixty plates four inches square.

Another cause of the increase of power in this pile besides liquidity is, that almost no oxide is formed on the surface of the amalgam of zinc and mercury, as is the case when a solid metal is used; for, as soon as the particles of zinc come in contact with the acid, they become oxidated; and as there is not the same cohesive attraction to hold them together as in the solid metals, they are immediately dissolved and taken up by the acid, the amalgam always presenting to the action of the acid a surface perfectly clear, free from oxide, and in the most favourable circumstances for generating and transmitting the galvanic state.

II. *On a New Galvanic Trough.*—Another galvanic apparatus, which I shall at present describe, is in the form of a trough, and is chiefly composed of liquids.

AB, Fig. 5. Plate II. is a wooden trough, eighteen inches long, four and a half broad, and about two inches deep, divided into nine equal parts by strips of glass *a a a*, &c. fully a quarter of an inch in height. These spaces are again subdivided by plates of glass *b b b*, &c. nearly the whole depth of the trough, each cell being rendered quite tight by a coating of wax. The trough will now be divided into eighteen separate spaces or cells, the first and last being formed by means of the higher plates, the others by a low and high one alternately. The trough being prepared in this manner, a quantity of pure mercury, merely sufficient to cover the bottom, is poured into the first space; and into the second space the same quantity of the liquid amalgam of zinc and mercury; into the third space pure mercury; and into the fourth the amalgam; and in like manner, until the whole spaces are charged.

By this means, we obtain a galvanic arrangement, consisting of pure mercury and an amalgam of mercury and zinc.

It will be observed, that the mercury in the first space is separated by one of the higher plates of glass from the amalgam of zinc and mercury in the second, and that again from the third by one of the lower plates of glass; and, in like manner, throughout the series. Arcs of copper wire *c c*, *c c* pass over the higher glass-plates, and dip on the one side into the mercury, and on the other into the amalgam of zinc and mercury; this serves to connect each pair of plates in the battery. If muriatic acid and water be now poured over the surface of both the amalgam and pure mercury, until it rises nearly to the top of the higher glass-plates or partitions, we shall have a complete communication established throughout the whole series of plates in the battery. The first and second by the arcs of wire, the second and third by the acid and water, and, in like manner, throughout the whole of them.

In this arrangement, the mercury and zinc become the positive plate, and the pure mercury the negative one. Troughs of this description may be connected with each other in the same way as is done with the ordinary galvanic troughs.

If the circuit be completed by more or less perfect conductors, the usual galvanic phenomena will be presented. The power of an arrangement of this kind is, however, inferior to that of the cups formerly described, or even to the common trough, with plates of the same size. This may depend on the distance of the plates of pure mercury from those of the mercury and zinc; as, from their liquidity, they cannot be directly opposed to each other, either vertically or horizontally, as in other constructions where either the positive or negative plate is solid. The transmitting power of a liquid battery of this kind is also very different from those of the ordinary construction. If it be connected with a battery composed of large plates, it transmits, without diminution, the full effect of it; the only difference observable being a greater evolution of hydrogen. This transmitting power seems to depend upon the liquidity of the plates, as a more rapid motion takes place among the particles of zinc in amalgamation with the mercury in the positive plate; and probably the oxidation of an equal number of particles takes place in the positive plates of both batteries in a given time, the one by its liquidity, the other by its surface presenting an equal number of points to the action of the acid.

In this arrangement, no oxide is formed on the surface of the metals; for, whenever the particles of zinc become oxidated, they are that instant dissolved and taken up by the acid. The action would consequently be of long duration, were it not that, by this process, the acid itself becomes charged with the zinc, and the negative plate reviving the metal held in solution, renders it positive, and restores the equilibrium.

If the little finger of each hand be placed into the extreme cells of a battery of nine plates, such as I have described, the shock will be quite perceptible; if two are used of the same size, viz. eighteen plates and small platina wires employed to form the circuit, the decomposition of water will be effected; and if twenty-seven plates are used, the shock will be considerable.

The electro-magnetic effects of this battery are very weak, which is owing to the arrangement as well as the size of the plates.

The only other form of galvanic apparatus which I shall at present notice, consists of a wooden trough AB, Fig. 1. Plate III., supported on four pillars, about four inches in height, the same size, and divided in precisely the same

*Fig. 1.*

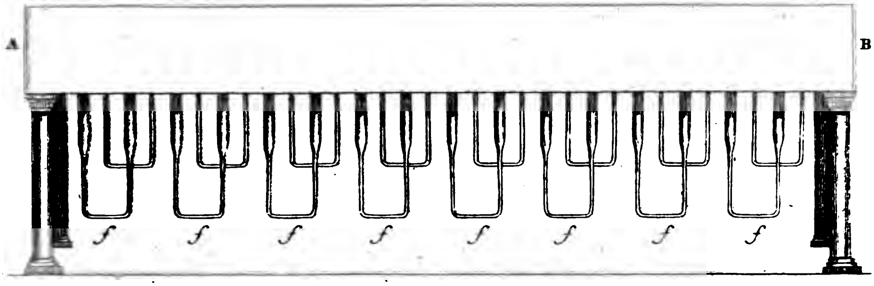


*Fig. 2.*

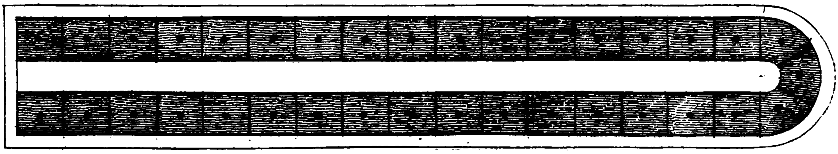


*Fig. 3.*

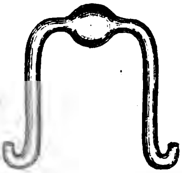


*Fig. 4.*

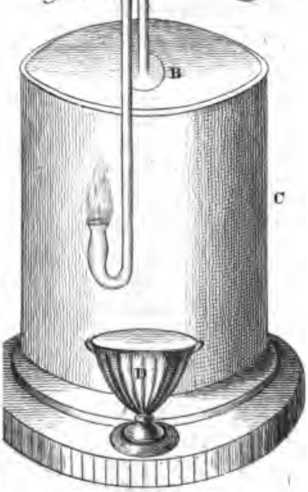
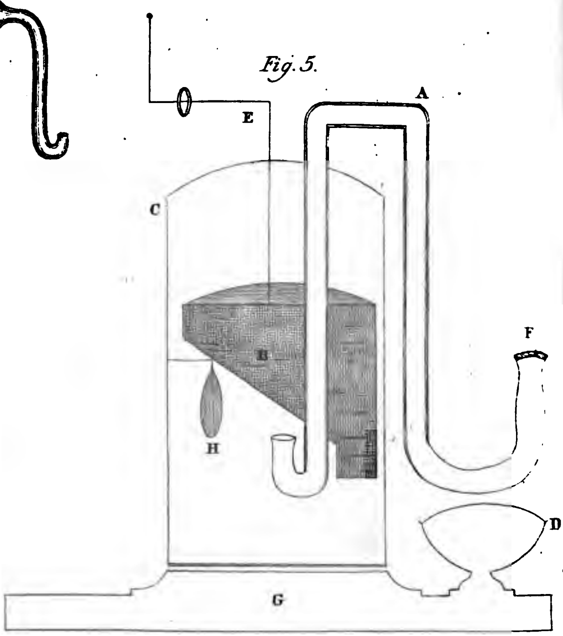


*Fig. 5.*



*Published by A Black Edinr. 1828.*

*E. Mitchell sculpt.*

manner as in the one immediately preceding; instead of arcs of copper-wire, *ff*, Fig. 1. Plate III. are syphons of glass which connect the spaces on each side of the higher glass divisions, being the positive and negative plates; they are inserted into the bottom of the trough by cement, and open into the spaces, —that part of the tube which opens into the trough, and for about one inch downward, being half an inch in bore, the rest of it being only about one-eighth part of an inch.

In charging this battery, a quantity of pure mercury is to be poured into the first space, sufficient to cover the bottom of it, and also to fill the whole syphon. When the mercury appears at the surface in the *opposite* limb, a cork is to be inserted, to prevent the mercury from filling the space it opens into. In the same manner we proceed to fill the whole of the syphons and alternate spaces. The remaining cells are then to be filled with the amalgam of mercury and zinc, and the corks removed. The two liquid metals will now be in complete contact, by means of the syphons of mercury. If water and acid be now poured over the surface of the metals until it rises nearly to the top of the *higher* glass divisions, a communication will be formed throughout the series, and we obtain a galvanic arrangement completely liquid, without a solid metal being either used for generating or transmitting the fluid.

The syphons, in this arrangement, might have occupied the same place as the arcs of wire did in the former one, by passing over the higher glass divisions; but the difficulty of filling them, and also of preventing the hydrogen rising in them and breaking the communication, induced me to have recourse to the plan I have adopted, in having them placed under the trough. If, in the present instance, the communication should be broken by the acid and water getting into the smaller part of the syphons, this can be easily expelled, by applying the flame of a candle to it, and the communication again instantly restored.

Two troughs of this kind being placed parallel to, and at the distance of half an inch from, each other, Fig. 2. Plate III., are connected by a glass syphon, passing from the one to the other, so as to form a continuous series; the other two ends will be the positive and negative poles.

I shall merely notice one experiment which I performed by this arrangement, viz. the decomposition of water: For this purpose I employed a small bent tube, Fig. 3. Plate III. in the form of a syphon, having a ball below in the bent part of it, and the ends of the limb slightly turned up, to prevent the escape of the liquid. This being filled with water, the limbs are to be plunged into a vessel containing mercury. Upon applying heat to the ball, a quantity of the water will be expelled, which will be immediately replaced by the mercury rising in both limbs of the tube,—the mercury should rise nearly to the bend of the tube. The syphon in this state is to be removed, and made to form the circuit in this arrangement. The hydrogen is immediately evolved, and rises into the ball, while an oxide appears on the surface of the mercury.

In this experiment is exhibited the decomposition of water, without the use of any solid metal, either for generating or transmitting the fluid [*].

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[*] These instruments are to be seen at No. 8. College Street, Edinburgh. Mr Kemp, we understand, proposes manufacturing a stock of them for sale.—Edit.

## *Experiments on the Velocity of the Circulatory Motion of the Blood, and on the quickness with which the secretions are performed.* By E. Hering, Professor at the Veterinary School of Stuttgard *.

These experiments, to the number of eighteen, were made on horses. There was injected, or rather infused, into the jugular vein, a solution of hydrocyanate of potash and iron. To introduce the liquid, there was employed a glass-tube, of the size of a writing quill, capable of being closed by means of a stop-cock, and surmounted by a brass funnel, holding two ounces of liquid. The tube being introduced into the vein, the funnel was filled, and the cock opened, to be shut again the moment the liquid had passed into the vein. In this manner the access of air was prevented. After some time, a vein was opened in another part of the body, and the blood examined by chemical reagents. The animals were killed some time after, and the traces of the liquid introduced was sought for in the secreting organs and their products. The second series of experiments is to form the subject of a separate memoir.

As a re-agent for discovering the hydrocyanate of iron in the blood, the author preferred the sulphate of iron to the sulphate of copper, or the hydro-chlorate of iron. To form a blue precipitate with this salt, it was only necessary to add a little hydrochloric acid. The hydrocyanate of potash and iron was also recognised, although existing only in the proportion of 1 to 20,000 in the serum of the blood. The small quantities of hydrocyanate not being discoverable in the coloured blood, it was necessary to let it rest from twenty-four to forty-eight hours to have a clear and limpid serum. Some drops were let fall on white paper, and there were afterwards added a few drops of a solution of sulphate of iron (1 gr. in 8 ounces of distilled water); a drop of concentrated hydrochloric acid, which was added in the last place, instantly betrayed the presence of the hydrocyanate. This procedure is equally applicable to the solid parts that are submitted to examination.

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* Zeitschrift für Physiologie, t. ii. p. 85.

Passing over the details of the experiments, we arrive at the results obtained by the author.

*1st,* A solution of hydrocyanate of potash and iron, introduced into the jugular vein of the horse, runs the course of the circulation, and arrives in the jugular vein of the opposite side, *in an interval of from twenty to twenty-five seconds* (Exp. 8, 10, 13, 14, 16) or from twenty-five to thirty (Exp. 12.) It arrives in from twenty-three to thirty seconds in the external thoracic vein of the opposite side (Exp. 5.), in twenty seconds at the vena saphena major (Exp. 4.), in from fifteen to twenty seconds in the masseteric artery (Exp. 6.), in from ten to fifteen, and in from twenty to twenty-six seconds in the maxillary artery; lastly, in from twenty to twenty-five, and from twenty-five to thirty seconds in the metatarsal artery, always on the opposite side to the place of injection (Exp. 18, and 16.)

If the liquid introduced by this injection is moved by the same means as the blood, the velocity of the motion must be the same in both. It appears that the velocity of this motion is not increased in the ratio of the number of pulsations of the heart; for in a horse, in which the pulse was sixty in the minute (Exp. 8.), and in two others in which it was from thirty-six to forty-four, and from forty-eight to fifty-two (Exp. 13, and 14.), the results were the same. Yet in another in which the pulse was from thirty to forty-four, the circulation was found to be some seconds slower.

*2d,* The hydrocyanate of potash and iron is promptly secreted by the serous membranes, but in small quantities; and this in the inverse ratio of their distance from the heart. Thus, the secretion commences by the internal surface of the pericardium, where it is also the most abundant; it then takes place in the pleura, the peritoneum, and, lastly, in the articular capsules. The cerebral cavities were opened only in a few cases; and there was never found any trace in them of the saline solution injected. In the other serous cavities, the presence of this solution was discovered two, three, four, seven, and fifteen minutes after injection. These moments were also those when the animal ceased to give symptoms of life.

*3d,* The mucous membranes secrete the injected solution less quickly than the serous. A few minutes are, however, sufficient to discover the foreign principle at their free surface; and, soon after, it is found at their other surface (Exp. 2, 6, 7, 15, 16.) The mucous membrane of the right half of the stomach secretes more promptly than that of the intestine, and the latter more quickly than the surface of the lungs (Exp. 6, 15, 16, 17.) Secretion is much slower at the genito-urinary surface; what was found of the solution in the urinary passages came only from the kidneys.

The mucous surfaces covered with an epithelium (as the walls of the mouth, the pharynx, the left half of the stomach, in the horse) gave no traces of secretion of the saline solution injected.

*4th*, The liver, the spleen, the thyroid gland, &c. allow the presence of the hydrocyanate to be detected only with difficulty, on account of their dark colour. The salivary glands appeared to perform a considerable part in the elimination of the foreign substance (Exp. 5, 6, 7, 16, 18.)

*5th*, The kidneys act also very powerfully. The re-agent manifests the presence of the hydrocyanate in the interval of one minute (Exp. 9.) in the cortical and tubular parts, and in the pelvis. The passage of the urine through the ureters being rather slow, the consequence is, that the bladder does not present traces of the foreign precipitate until after a pretty long interval. The small bloodvessels of the kidneys gave signs of reaction, while the large ones gave none; whence it might be concluded, either that the circulation is slower in the former, or that the hydrocyanate already commences beforehand to separate from the blood.

*6th*, In the lungs this salt is not so difficultly discovered as might have been presumed.

*7th*, The saline solution adheres in some cases to the walls of the bloodvessels, and is then easily discovered by the re-agents (Exp. 15, 18.); more frequently it does not adhere to them (Exp. 5, 16, 17.) Sometimes it adheres in some of them and not in others (Exp. 6.) The cause of this difference is unknown.

*8th*, The shortest time which the solution takes to reach the thoracic duct is still undetermined. A minute sufficed in one case (Exp. 9.), and from two to five minutes in others (Exp.

18, 10, 7, 15, 6, 5.) It is only discovered a little later in the lymphatic ganglia, although it already occurs in the thoracic duct. It, therefore, would appear, says the author, that there is a direct communication between the arteries and lymphatic vessels.

9*th*, The foreign substance introduced into the blood is quickly ejected by the secreting organs, especially by the kidneys. The diminution was perceptible after a few minutes, in Exp. 3, 4, 8, 15. In from five to eight hours there no longer remained any traces of it in the products of the secretions; and, in twenty-four hours, all traces had disappeared, even from the solid parts (Exp. 13.)

10*th*, Lastly, there results from these experiments, that the hydrocyanate of potash and iron may be mixed with the blood without inconvenience to the animal. A solution of indigo has not the same advantage (Exp. 11.) A solution of sulphate of iron injected into the blood coagulates it, and speedily causes death.

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## *Account of the* Tænia *found in the Intestines of the Common Grouse* (Tetrao scoticus). By JOHN SCOULAR, Esq. Communicated by the Author.

THE public are indebted to the valuable and interesting observations of Robert Wallace, Esq. of Kelly, for the first information of the great numbers of worms found in the intestines of the *common grouse* (Tetrao scoticus); and it must be alike interesting to the sportsman and the naturalist, to receive some particulars of the nature of a disease so common during this season, and which has proved so prejudicial to the game. To the kindness and liberality of Mr Wallace, the writer is indebted for many valuable remarks on the subject, and for opportunities of examining the bodies of some birds affected with the disease. The birds which labour under it are easily distinguished from those in a state of health, even while on the wing, by the weakness of their flight, and the languor of their movements. On opening some grouse which had been killed in this unhealthy condition, the small intestines were found to contain an astonishing quantity of worms, clustered together in knots, and even distending the coats of the intestines. On laying open the intestines, the worms were found among a great portion of intestinal mucus. In some cases, the intestines had been perforated, and the animals had escaped into the cavity of the abdomen, although none of their other contents had been thus evacuated. The bodies of the worms completely filled up the openings. On examining the worms, they proved to be the *Tænia linea* of Rudolphi, which that distinguished naturalist had found to exist within the quail, while in Italy. The head of the animal is globose, the neck long and capillary, and the posterior articulations campanulate or infundibuliform; length of body 12 inches.

The condition of the internal organs of the birds thus affected, appeared to be in no respect different from that of healthy individuals; except in the quantity of mucus in the intestines, which appeared to afford a favourable nidus for the development of the ova of the *Tænia*. This circumstance may perhaps assist us in ascertaining the cause of the disease. When we remember the abundance of moisture that prevailed at the commencement of the present year, and the probably wet nature of the food which the grouse were obliged to use, we may easily comprehend how debility and disease of the intestines would be induced, affording thereby a favourable habitation to these parasites; so that in this, as in most similar cases, the presence of *Tænia* is not *a cause*, but *a consequence*, of the weakness of the birds. In many instances, worms of different kinds are found in animals, causing apparently little or no inconvenience. We have detected different species of *ascarides* in considerable quantity, in the œsophagus of birds and of serpents, which appeared in no respect unhealthy. Even hundreds of worms may exist in the liver of the shark, without rendering him less active and vigorous. It is only when these animals infest organs whose texture is readily injured, and which are of immediate vital importance, that they are capable of producing fatal effects, as in the case of the *Distoma cylindraceum* in the lungs of frogs; and even then they are probably caused by the previous disease of the parts. On the other hand, some circumstances render it likely that improper diet exerts an influence upon animals favourable to the production of worms. Thus rabbits, fed on very succulent food, have generally their liver and abdominal organs affected with a species of *hydatid*, the *Cysticercus pisiformis*; and a similar occurrence is related by Bremser in his work on the Intestinal Worms of Man.

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## *On a Method of so far increasing the Divergency of the two Rays in Calcareous-spar, that only one Image may be seen at a time.* By WILLIAM NICOL, Esq. Lecturer on Natural Philosophy. Communicated by the Author.

THE following simple method of constructing a prism of calcareous-spar, so that only one image may be seen at a time, will, perhaps, prove interesting to those who are in the habit of examining the optical properties of crystallised bodies by polarised light.

Let a rhomboid of calcareous-spar one inch long be reduced in breadth and thickness to three-tenths of an inch; let the obliquity of its terminal planes be increased about three degrees; or, in other words, let the angles formed by the terminal planes, and the adjoining obtuse lateral edges, be made equal to 68°, by operating on the terminal planes: these planes may now be polished. The rhomboid is then to be divided into two equal portions, by a plane passing through the acute lateral edges, and nearly touching the two obtuse solid angles. The sectional plane of each of the two halves must now be made to form exactly an angle of 90° with the terminal plane, and then carefully polished. The two portions are now to be firmly cemented together by means of Canada balsam, so as to form a rhomboid similar to what it was before its division.

If a ray of common light fall on the end of such a rhomboid in a direction parallel to the lateral edges, the two rays into which it is divided, in passing through the spar, will deviate so far from each other, that only the ordinary image will be seen. That image, too, will appear exactly in its true position, and free from colour. The range of the ordinary ray will be found considerably greater than the whole field of vision, as may easily be seen by making the rhomboid revolve on an axis parallel to the longer diagonal of the terminal planes. There is a tinge of blue where the ordinary ray vanishes on one side, and a tinge of orange, accompanied by a number of extremely minute obscurely coloured fringes, where it terminates on the other. If the rhomboid revolve beyond the fringes, the ordinary image will disappear, and the extraordinary image come into view. The latter, however, from the great obliquity of the incident light, occupies a smaller range, and is less distinct than the other. The ordinary ray passing out of the rhomboid in a direction parallel to its lateral edges, is therefore the best adapted for analytical purposes; and as calcareous-spar, when pure, and free from flaws, is not only transparent, but perfectly colourless, a rhomboid of that substance, of the above construction, developes the coloured rings of crystallized bodies with a degree of brilliancy not to be equalled by a plate of tourmaline, or perhaps by any other substance.

With the view of rendering the structure of the analyzing rhomboid more easily understood, I have supposed a piece of the spar to be divided into two equal portions. Such a division, however, would be a difficult task; but if two similar pieces of spar be taken, it will be found a very easy matter to remove one-half of each of them, either by grinding, or by the action of a file. The pieces of spar should not be much less than an inch long, and they need not be longer than 1.4 inch. If the latter dimension be adopted, the breadth and thickness will require to be about .48 of an inch.

In cementing the two pieces together, it will be proper to let the pointed end of the one project a little over the terminal plane of the other. By so doing, a more firm contact is obtained at the edges; and when the cement is sufficiently indurated, the whole of the projecting parts may easily be removed, according to their cleavages. The lateral planes should be left quite rough, to prevent the reflection of extraneous light.

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## *Theory of Compression applied to discover the Internal Constitution of our Earth.* By Professor Leslie. Communicated by the Author.

The subsequent note is contained in the new edition of my *Elements of Natural Philosophy*, about to be published. It contains a rapid sketch of some curious speculations relative to the internal structure of our globe, which I purpose soon to expand and illustrate. In the mean time, I shall offer a few preliminary remarks.

Though we must not push the law of compression to its utmost extent, we may safely infer that it stretches far beyond the limits of ordinary experiments. Air has been condensed 120 times, without betraying any sensible deviation from the principle, that its elasticity is proportionally increased. Water was rendered 1–36th part denser under a powerful compressing engine by Abich and Zimmerman in 1779. Nor can it be doubted, that, with a higher pressure, and more elaborate machinery, much greater changes could be effected in the constitution of these fluids

We may hence fairly conclude, that our planet is not composed of an accumulate mass of such materials as are found near its surface, but is very widely cavernous. But how can this vault be sustained, and what rare medium can exert such a vast repulsive energy as to poise the enormous compression of columns 3500 miles in altitude? *Light* alone seems to possess the character of extreme rarity, united with elasticity of transcending force. It is known in two very different states—in rapid emission, or in latent combination with other substances. But may not this subtle fluid exist as a distinct collected body, its repulsive efforts being restrained either by compression or the mutual attraction of its remote particles ?

It is an important consideration, that light must be emitted from every substance with the same celerity, for it otherwise would not be fit to serve the purposes of vision. By comparing that extreme rapidity with the rate with which air would rush into a *vacuum*, we are enabled to compute its propulsive power, and contrast its prodigious elasticity.

" This capital experiment in the text was first devised and performed on a small scale by Mr Canton in 1760. It established incontestibly the compression of water, but seems to have been generally overlooked by succeeding popular writers, many of whom still continue to repeat the erroneous conclusion of the Academicians *del Cimento*, which represents that fluid as absolutely incompressible. The instrument alluded to holds about 12 ℔ of water, which was introduced with great care and patience: the contraction and subsequent dilatation in the stem, from abstracting and restoring the pressure of nine-tenths of an atmosphere, amounts to 3 or 4 inches, and is rendered visible at the distance of several benches in a large class-room, by help of a drop of quicksilver resting on the top of the aqueous column.

I have likewise had constructed by our ingenious young optician Mr John Adie, a large and delicate instrument, suggested by the plan of Oerstedt, and capable of extensive application. It bears safely a pressure of 12 or 15 atmospheres, and not only measures easily the contraction of different fluids, but serves to indicate the various compressibility of solid substances. From a series of experiments which I have instituted, I may venture to anticipate the detection of some interesting and important facts in the economy of Nature.

The theory of the compression of bodies, carried to its full extent, might give rise to several bold but striking speculations regarding the internal constitution of our globe. Let the density of any substance, at a depth corresponding to the distance $x$ from the centre in miles, be denoted by $d$, (that at the surface being assumed the unit), and the radius and the modulus of elasticity expressed by $r$ and $m$. Since the power of internal gravitation is directly as the distance from the centre, it will be elsewhere demonstrated *, that Hyp. Log. $d = \frac{r^2 - x^2}{2mr}$, or, adopting common logarithms, and inserting the numerical values,

$$\text{Log. } d = \frac{3956^2 - x^2}{18218\, m}.$$

For Atmospheric Air, this *formula* becomes

$$\text{Log. } d = \frac{3956^2 - x^2}{91090}.$$

For pure Water, it passes into

$$\text{Log. } d = \frac{3956^2 - x^2}{2415707}.$$

And for White Marble, the *formula* is,

$$\text{Log. } d = \frac{3956^2 - x^2}{7287200}.$$

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* See *Elements of Natural Philosophy*, vol. ii.

Hence it may be computed, that if the same law of condensation continued, Air would become as dense as Water at the depth of $33\frac{3}{4}$ miles; it would even acquire the density of quicksilver at a farther depth of $163\frac{1}{4}$ miles.

The idea which I formerly threw out in the article Meteorology, of the Supplement to the Encyclopædia Britannica, that the ocean may rest on a subaqueous bed of compressed air, is therefore not devoid of probability. Supposing the rate of contraction were to proceed more slowly than at first, still the required measure of condensation would be attained at a depth which forms a very small part of the radius of the globe.

But Water, under the weight of an enormous column, must likewise largely contract. At the depth of 93 miles, it would be compressed into half its former bulk; and at the depth of $362\frac{1}{5}$ miles, it would acquire the ordinary density of quicksilver, Even marble itself, subjected to its own pressure, would become twice as dense as before, at the enormous depth of $287\frac{2}{5}$ miles.

It is curious to remark, that, from its rapid compressibility, air would sooner acquire the same density with water, than this fluid would reach the condensation of marble. For the coincidence of Air and Water, the *formula* becomes

$$x^2 = 15649936 - \frac{2415707 - 91090}{2320617} \text{ Log. } 840; \text{ whence the}$$

depth is $35\frac{1}{3}$ miles.

For equal densities of water and marble, the *formula* is

$$x^2 = 15649936 - \frac{7287200.2415707}{4871493} \text{ Log. } 2.34; \text{ and the depth}$$

descends to $172\frac{9}{10}$ miles.

If we calculate for a depth of $395\frac{3}{5}$ miles, which is only the tenth part of the radius of the earth, we shall find that Air would attain the enormous density of 101960 billions; while, at the same depth, Water would acquire but a density of 4.8492, and Marble only 3.8095.

At the centre of the earth, the several *formulæ* will become simpler. The logarithm of the final augmented density would be for Air $\frac{15649936}{91090}$, for Water $\frac{15649936}{2415707}$, and for Marble $\frac{15649936}{7287200}$. Air would hence reach the inconceivable density expressed by 764 with 166 cyphers annexed, while Water would be condensed 3009000 times, and Marble acquire the density of 119.

Such are the prodigious results deduced from the law of gravitation, even supposing the structure of the globe were uniform. But if we take into the estimate the augmented power from condensation, the numbers would become still more stupendous. It follows, therefore, that if the great body of our earth consisted of any such materials as we are acquainted with, its mean density would very far surpass the limits assigned by the most accurate investigations. The astronomical observation by Dr Maskelyne on the deflection of a pendulum, caused by the attraction of the sides of Mount Schehallien, and the nice experiments made with the *Balance of Torsion* by Mr Cavendish, on the mutual action of ponderous balls of lead,—nearly concur in representing the mean density of the globe as only about *five* times greater than that of water. It seems, therefore, to follow conclusively, that our planet must have a very widely cavernous structure, and that we tread on a crust or shell whose thickness bears but a very small proportion to the diameter of its sphere. Physical science can extend her prospects to the farthest verge of possibilities; but Chemistry, even in its present advanced stage, fails altogether in aiding inquiry; and the various hypotheses framed by geologists are built with such scanty and slender materials, as to furnish no safe guidance through those boundless speculations.

It is evident, that immense compression would totally derange the powers of elective attraction, and change the whole form and constitution of bodies. When air becomes denser than gold, it is hard to conjecture what transmutations this plastic fluid must undergo. The bowels of the earth may contain substances thus transformed, bearing no longer any resemblance to their aspect on its surface.

But since an absolute void is inadmissible, the vast subterranean cavity must be filled with some very diffusive medium, of astonishing elasticity, or internal repulsion among its molecules. The only fluid we know possessing that character is LIGHT itself, which, when embodied, constitutes *Elemental Heat* or *Fire*. It is elicited from every substance by percussion or compression, by electrical agency or chemical affinity. With every species of light our vision is equally perfect; and, consequently, the luminous particles must, in all cases, dart forward with the same celerity, or travel at the rate of about 200,000 miles in a second. But since atmospheric air is projected into a vacuum with the velocity of only a quarter of a mile each second, the motion of light is thus 800,000 times more rapid. Wherefore, the propulsive force of light compared with that of air is expressed by the square of this number, or 640 billions; and hence its *Modulus of Elasticity* must amount to the stupendous column of 3200 billions of miles, an extension which is 889 times greater than the diameter of the orbit of Uranus, the most distant of the planets yet discovered. Only such surpassing powers of repulsion would appear at all adequate to balance the cumulative mass of compression, and restrain the condensation of our globe within moderate limits.

We are thus led, by a close train of induction, to the most important and striking conclusion. The great central concavity is not that dark and dreary abyss which the fancy of poets had pictured. On the contrary, this spacious internal vault must contain the purest ethereal essence, *Light* in its most concentrated state, shining with intense refulgence and overpowering splendour."

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## *On the Deror of the Hebrew Scriptures, translated Swallow in the English Bible.* By DAVID SCOT, M. D. M. W. S. Communicated by the Author.

DEROR is the name of a bird twice mentioned in the Hebrew scriptures, first in Psalms lxxxiv. 3. "The sparrow buildeth for herself a house, and the *swallow* a nest, where she may bring forth her young, even thine altars, my God and King;" and then in Prov. xxvi. 2. "As the bird by wandering, as the *swallow* by flying, so the curse causeless shall not come."

In this last passage the original term *zippor*, is translated bird, which, in the other, is translated sparrow, and such is understood to be its meaning. As a proof that this is its true sense, zippor very much resembles the chirping of a bird in general, and of the sparrow in particular; and the cry of quadrupeds and birds is a principal source from which they get their names in the Hebrew scriptures.

It may be the wish of one that utters a causeless curse, that it may come as rapidly upon him, against whom it is uttered, as the flight of a deror, or the wandering of a zippor; but while the providence of God directs, it shall not come, if it come at all, in that manner.

As to the word *deror*, occurring in both passages, whatever it may signify, it is evident, that our translators have fixed upon *swallow* as its meaning in the last passage, because they found it convenient so to translate it in the first; and, before we can determine any thing about deror, we must ascertain the real meaning of the first passage, which interpreters have found or made difficult.

Now, it must be confessed that the way in which Psalm lxxxiv. 3. is rendered in the English Bible, as quoted above, very much countenances the idea, that swallow is meant by deror.

As the sparrow frequents houses, and builds its nest about the eaves; so also two species of swallow frequent houses, one of which builds its nest in windows, and the other in chimneys; and, in this passage, if the sparrow be the one bird, as we are not disposed to question, may not the swallow be the other, as it resorts to the dwellings of men, and in these makes its house and builds its nest?

At first sight, then, the translation of this passage in the English Bible seems unexceptionable; but, when carefully examined, it will be clearly discerned that some other translation is absolutely necessary, though it may not so much favour the idea that deror is a swallow.

*First*, it is perfectly certain, that, if the translation of the English Bible be retained, altars cannot be taken in a literal sense. There were two altars used by the Jews in their worship of God, the altar of incense, and the altar of burnt-offerings. The altar of incense stood at the side of the veil, before the holy of holies; whether within or without, is disputed; and was always under cover. No swallow could get access to it, however anxious to build upon it a nest, more than the sparrow, if it wished to make it a house.

The altar of burnt-offerings, indeed, stood in the open air, and could not be covered, as it was constantly in use; but there no sparrow could make its house, or swallow build its nest, as sacrifices were offered upon it evening and morning; and, if either bird should attempt to do so when the priests were absent, it would be effectually prevented as soon as they returned.

*Secondly*, Altars may be taken in a figurative sense for the Tabernacle, if the words are those of David; or for the Temple, if they are the words of men, posterior to David; but even this sense, after a careful examination, will be found as untenable as the literal, if the English translation is retained.

No well informed person can ever bring himself to believe, that the sparrow could make a house, or the swallow a nest, either on the Tabernacle or Temple. There was such a concourse of people about the Tabernacle and Temple, and such a care taken to keep them clean, that birds were hardly allowed to light upon them, far less to build nests upon the sides or corners of them.

Supposing altars to signify the Temple of Solomon, which stood to the Babylonish captivity, birds could not build their nests upon any part of it, as the pollution of a place so sacred could never be tolerated; and even if they had attempted to build them, they would have been opposed by the machinery erected on the top, in order to keep them at at a distance.

In Zerrobabel's Temple, at least, which stood to the time of Herod the Great, and in Herod the Great's Temple, which stood to the destruction of Jerusalem by the Romans, all birds which were disposed to approach the one or the other, were frightened away by the *cule oreb*, often mentioned in the Talmud, or engine that drove away ravens, as the phrase literally signifies, though certainly implying birds in general.

As there was the same occasion for such a machine while the Tabernacle of Moses and Temple of Solomon stood, it was highly probable, that something of the same kind was erected on some part of the one, as well as the other, though not mentioned by the sacred writers, nor even by Josephus, the Jewish historian.

He notices, however, such a machine attached to Herod's Temple; and Eupolemus, quoted by Eusebius, describes the following as belonging to Solomon's Temple: "Solomon made two brazen nets, furnished with rings; and set them on beams, raised 20 cubits above the Temple; and they overshadowed all the Temple; and he suspended 400 large bells from the nets; which were so constructed as to ring the bells and drive away the birds; lest they should light upon the Temple, nestle in the ceilings of its gates and porches, or defile it with their fœces."

For these reasons, then, we apprehend that the translation of the English Bible is wrong, whether understood literally or figuratively; and another translation must be adopted, unless we would make the Psalmist assert things which could never happen.

Of translations given by learned men, we shall notice two, either of which we scruple not to prefer to that of the English Bible. The first of these translations is that of Noldius, which supposes an ellipsis of the verb *find*; and this ellipsis, notwithstanding what Parkhurst has said, cannot be thought harsh or unusual; "Even as the sparrow findeth for herself a house, and the deror a nest, so also *I would find* thine altars, my king and God." The other is that of Durell: "As the sparrow findeth for herself a house, and the deror a nest; *I* also *would approach* the altars, my king and God;" the word *at* in the original being taking as a verb, instead of *ate*, and not as a particle before the objective case, seldom translated.

Whichever of these translations is adopted, we are under no necessity of translating deror *swallow*, as the English interpreters were, because they ignorantly supposed that there was no other bird which could be associated with the sparrow, while it made its house about the altars of God.

If the word *swallow* only be wrong in the common translation, Dr Russel's History of Aleppo has taught us, that there is a brown dove which builds its nests in the windows of houses in that city; and, if the sparrow can really make the altars of God its house, and some other bird make them its nest, it would have been far better to have made this species of dove the companion of the sparrow, than the swallow.

As, however, the reasons already given shew the other parts of the common translation to be wrong, that of Noldius or Durrell must be adopted, which makes altars relate to the Psalmist, and not to any birds whatever.

According to either of these translations, the sparrow can make a nest for herself, in a place reckoned convenient, and the deror its nest, where it can bring forth its young undisturbed. Each has a home to which it can come as a dwelling, whenever it pleases, and every desire and affection be fully gratified.

Not so was the condition of the Psalmist; and the strong sense which he had of it, made him utter words very like the pathetic declaration of our Lord. "The foxes have holes, and the birds of the air have nests, but the Son of Man hath not where to lay his head." The sparrow findeth for herself a house, and the deror a nest, but I am not allowed to approach the tabernacle of God, in which I would dwell for ever, or worship him in his sanctuary, which I count the greatest of blessings.

Having cleared this passage of the mistakes of commentators and translators, without offering the least injury to the original, we are prepared to investigate what kind of bird is understood by deror; and especially, whether it be the swallow, as it is said to be in the English Bible.

Now, without the least limitation, we are authorised to say, that all the ancient versions are against the swallow. The Chaldee paraphrase pronounces deror to be the dove, the Septuagint and Vulgate translations, the turtle dove; the Ethiopic, the ring dove.

That deror could not be the swallow, we are inclined more to think, because *sis* * is the Hebrew term for that bird; and why, it may be asked, is not *sis* used in the two passages, in which deror occurs, if the swallow be intended?

To this account it may be objected, that the *trygon* of the Septuagint, and the *turtur* of the Vulgate, cannot be the right translation of deror, as these interpreters employ the same terms to denote *tur* of the Hebrews, which all acknowledge to be the turtle dove. In answer, the Septuagint and Vulgate seem to have mistranslated deror, not so much from mistaking the original, as from the want of a proper word to express its true sense. There are at least 70 species of dove, few of which have a proper name; and these interpreters did in this, what they have done in other cases; they made choice of a word which expressed a dove very like deror, because they had not a better.

Thus much we may infer from their translation, that deror, at least, was a wild dove; and its true meaning agrees very well with the idea of a bird uncontrolled. It signifies *freedom* or *free*, which is a term very appropriate to the wild dove, as opposed to the tame. The tame dove is generally found near the habitations of men, and makes short excursions when it goes abroad. On this account, it is, with great propriety, called *peristera katoikidea*, or house dove. The wild dove, on the contrary, though it does not altogether avoid the residence of men, and, according to Varro, occasionally resorts to turrets, spires, and pinnacles; yet it is much about the fields, and, on that account, may be called *Columba agrestis*, or field-pigeon.

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* A memoir on the *sis*, or true swallow of the ancient Hebrews, and not the crane, as the English translators of the Bible make it, was read by the author before the Wernerian Nat. Hist. Soc. Nov. 29. 1828.

Men would be ready to call wild doves deror, or unrestrained, when they observed them flying at will over a vast range of territory, though they might not forsake it during the whole year; or, from sagacity or instinct, visiting, without interference, other countries in the spring or autumn.

The swallow, we may be told, deserves the epithet of free, because it is a bird of passage; and is remarkable for its rapid and easy turns in flying while it remains in a country; and in the spring and autumn leaves one country and goes to another, without any other impulse but that of mere instinct.

On this ground, all other birds may be called free, who are not confined to a cage, and allowed the use of their wings: they acknowledge no master, but flutter from tree to tree during the day, and roost in any branch during the night.

At the same time, it cannot be denied, that this epithet is more suitable to swallows than other birds, the dove excepted, because there are some that haunt the woods, and may be called wood swallows, in opposition to the house ones, or those that frequent houses.

This distinction at least is agreeable to Ovid:

> ——— quarum petit altera sylvas;
> Altera tecta subit.——*Metamorph.* lib. vi. fab. 8.

are his clear but comprehensive words. But while he makes one, we know there are two species of house-swallow; and, if all the other species are to be included in the house-swallow, there are at least nine of these species. He might lay claim to high merit as a poet, but he never pretended to be a systematic naturalist, and far less to anticipate the classification of posterity.

But if there be house swallows and wood swallows, there are no tame swallows, as contrasted with wild swallows. All of them are *wild*, all equally the children of freedom, whether they approach the habitations of man, or skim along the extended moon, resort to the solitary mountains, or retire to the sheltered valleys. This account, however, cannot be given of the dove. There is a tame dove and a wild dove; one that is subdued by man, familiarised to his presence, and frequent about his dwelling; and others that spurn his dominion, laughs at his commands, and roams wherever he pleases.

The Hebrews, then, made excellent use of this distinction, when they called the wild dove *deror*, or free, in opposition to the tame one, which was more under restraint, and did not feel inclined to throw off the interference of man, under whose protection it had come.

As they gave it this name, because it was not subjected to control, as the tame dove might be considered; so Basil, for a similar reason, gave to a collection of those doves, the name of *ten agelan ten oikonomon*, the self directed-herd.

What species of wild dove is meant by deror is not easy to determine. We are confident it was a species well known in Palestine; and are very much inclined to think that it was one or other of these three species, the brown dove of Russel, already referred to, mentioned in his History of Aleppo; the migratory dove of Alexandria, mentioned by Forskal; or the ring dove, the same as the palumbus or wood pigeon.

The ring dove is not mentioned in the Hebrew scripture, unless it be the deror. We have already seen that deror is translated ring dove, by the Ethiopic interpreter; and we observe that Bishop Horne has adopted this translation.

We do not know whether the brown dove of Aleppo continues in that neighbourhood all the year, but, as it builds its nest in the windows of houses in that city, it must have been known for a long time in that quarter, probably, as far back as the days of David and Solomon.

As to the migratory dove of Alexandria, noticed by Forskal, there is this remarkable circumstance concerning it, that it is called *derori*—the very name in Hebrew belonging to that bird, which we are now considering, and whence arises a strong presumption, that deror may be this very species of dove; much stronger, indeed, than can be brought for any other bird.

If this dove appeared at certain times of the year at Alexandria, it might do so also at Palestine. In that case, the authors of the Psalms and Proverbs would be well acquainted with it, and their countrymen readily understand what bird it was, when they had occasion to mention it.

This bird seems to have some resemblance to the passenger dove of America, which goes southward and northward, in immense flocks, at certain times of the year; and, like all other species of dove, has uncommon strength of wing, and can fly long and far without wearying.

Upon the whole, we are perfectly convinced, that the deror of the Hebrew scriptures is not a swallow, as many have understood it, but a species of wild pigeon. It is very likely to be one of three species now mentioned; but we would require to know more of the history of each, before we should be able to say which of the three it was.

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## *Description of a Syphon Lamp, with Figures.* By LAURENCE DAVIDSON, Esq. Surgeon, Dundee. Communicated by the Author.

IN performing some experiments last winter, I was struck with the possibility of rendering the syphon far more extensively useful, by attaching it to a float capable of supporting it, without resting at all on the side of the vessel, as it does in common cases.

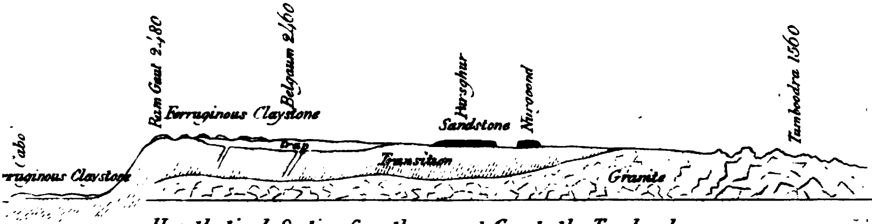
In the usual application of the syphon, the effect of the fall of the liquid in the vessel is evidently to bring the two columns of liquid in the legs of the syphon nearer and nearer to the same length; and, consequently, to diminish the quantity of liquid discharged in a given time.

Now, if the syphon be kept floating, it is evident, that, though the liquid falls in the cistern, the difference between the length of the two legs remains the same; and consequently *(cæteris paribus)* the quantities of liquid discharged in equal times will be equal.

Of the various applications of which the floating syphon is capable, a very simple one is for a lamp which may be used either with or without a wick, and which has been found to burn for months together with a uniformly regular flame.

PLATE IV.

Fig. 1.



*Hypothetical Section from the sea at Goa to the Tumboodra.*

Fig. 4.

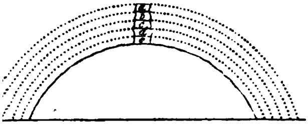


Fig. 3.

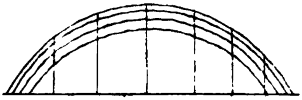


Fig. 2.

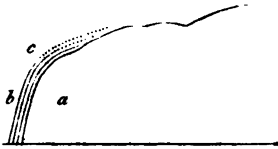


Fig. 5.

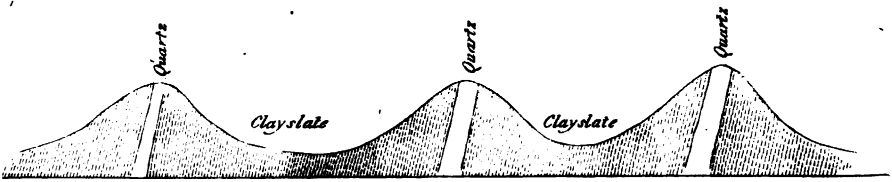
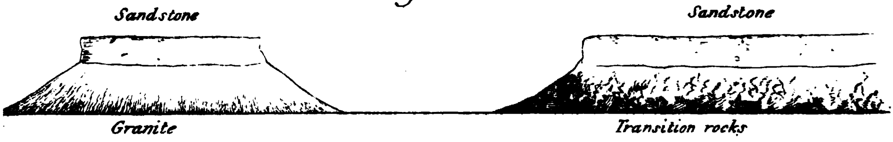


Fig. 6.



**GEOLOGICAL SECTIONS OF THE SOUTHERN MAHRATTA COUNTRY.**

Published by A. Black Edin. 1828.

E. Mitchell Sculp.

## *Description of the Sketch.*

Fig. 4. Plate III. Represents a front view of the lamp.

Fig. 5. A section of the lamp.

A is a syphon with equal legs, having both extremities turned up; but when it is made of glass, and is intended to be used without a wick, the burner extremity must be considerably more turned up than the other.

The syphon A slides in an oval or oblong float B, which may be made of cork, or any other light substance.

C is an oval or oblong vessel, in which the float B can move easily up and down. At one side of the vessel C, is a small cup D, intended to receive any oil that may run over, and which then collects in the cavity G.

Having adjusted the syphon in the float, so that it passes over its transverse diameter, we fill the syphon with oil, and plunge the float into the vessel C, which should be nearly full of oil; and then, by means of the wire E *, the float is to be slid up or down on the syphon, until the oil is almost running over at the extremity F, when the lamp may be lighted, and will continue burning until the syphon comes to touch the bottom of the vessel.

If the above be thought worthy of a place in your Journal, its insertion will oblige your obedient servant,

LAURENCE DAVIDSON.

To Professor JAMESON,
Edinburgh.

DUNDEE, *August* 15. 1828.

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Mr Davidson, in answer to my query, whether the lamp had been used by him, and found to answer well, says, " I beg to state, that my father (Dr Davidson, of Marischal College, Aberdeen) used the syphon lamp without a wick, during the greater part of last winter, as a night lamp. It was found to burn with an uniform steady light for months, without the least trouble, excepting now and then cleaning the glass burner, and filling the lamp with oil. I have also one burning in my surgery here, with a wick; and from the oil being kept always at the same level, it does not require snuffing during the whole evening.—EDIT.

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* The wire E also serves the purpose of receiving small weights to counterbalance the weight of the syphon.

But these may be rendered unnecessary, by altering the form of the float, &c., as by making the float in the shape of a horse-shoe, and the oil vessel to correspond. The addition of a weight at H tends greatly to steady the float and keep it properly balanced.

## *Sketches of the Meteorology, Geology, Agriculture, Botany, and Zoology of the Southern Mahratta country.* By ALEXANDER TURNBULL CHRISTIE, M. D. Member of the Wernerian Society. With a Plate. (Continued from page 304. of preceding volume.)

### *Geognosy.*

THE geognostical arrangement of the rocks of the Indian Peninsula is every where very simple; and a great uniformity prevails throughout the whole country, from Cape Comorin, even as far as the Ganges. The same formation, in many instances, extends, uninterruptedly, for several hundred miles in the same direction; and, consequently, that great variety, and those frequent changes within a short distance, which are so conspicuous in Britain, are seldom met with among the rocks of India.

The principal rocks in the peninsula of India are granite, transition rocks, old red sandstone, trap rocks, and, superior to all these, a ferruginous claystone. The Darwar district, and the adjoining coast, contain specimens of all these rocks; and will, therefore, serve as an example of the general geognostical structure of the peninsula.

### *Granite.*

This appears to be the most abundant rock in the peninsula of India. It stretches, with few interruptions, from Cape Comorin to beyond Nagpore and Ellichipore, occupying a great part of the Carnatic, Malabar, and Mysore, nearly the whole of the Nizam's dominions, and a large part of Barar[*]. It is also met with in many places still farther north, viz. in Malwa[†], Bundelcund[‡], and in the neighbourhood of Delhi[§]; and Lieutenant Gerard found some of the highest of the Himalaya Mountains to be principally composed of it[||].

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[*] I state this principally upon the authority of the late Dr Voysey, whom I met at Hydrabad, in 1823; and I myself travelled through a great part of the Nizam's dominions.

[†] Vide Malcolm's Central India, vol. ii. Appendix.

[‡] Vide Transactions of the Wernerian Society of Edinburgh, vol. iv. p. 26.

[§] Vide Transactions of the Geological Society of London, New Series, vol. i. p. 1, 2.

[||] Ibid. p. 127. *et seq.*

All the eastern part of the Southern Mahratta Dooab, from the Sungum[*] of the Kistnah and Tumboodra, to near the British frontier, consists of granite[†]; but west of that, viz. in the British territory, it only occurs occasionally, protruding in a few spots through the schists by which it is covered. It also occurs in the southern parts of the district; the Mysore granite extending, in some places, as far as, but seldom much beyond, the frontier. But although it be met with in comparatively small quantity in this district; yet, considering its very great importance as connected with the general geognosy of India, I will not confine myself to the appearances exhibited by the few specimens met with here; but will also avail myself of the observations I have been enabled to make on the granite in other parts of the peninsula.

The granitic tracts of India exhibit the same general features as granitic countries in other parts of the world. Rugged hills, with bold denticulated outlines, lie heaped together in the greatest irregularity, or occasionally form an obscure ridge, the crest of which, when interposed between the spectator and the evening or morning sun, presents the most fantastic forms. Some of these ridges, when their dark outline is seen at twilight, against a ruddy western sky, emulate, in their varied forms, the capricious shapes of summer clouds; and we can then trace along their summits the appearances of castles, trees, men, and various fantastic groups. Many of the hills have the appearance of collections of large fragments of rock thrown confusedly together by some convulsion of nature; while frequently larger masses, piled with great regularity on each other, look like the gigantic remains of cyclopean architecture. Huge insulated masses, forming considerable hills, in many instances, rise abruptly out of a plain, to a height of several hundred feet, and present nearly perpendicular faces on several of their sides; thus affording situations of immense natural strength, which have almost invariably been taken advantage of by the natives for the erection of forts. These insulated hills are generally met with at the edges of the granite tract, where it is succeeded by the transition rocks; and being situated in the midst of very extensive plains, when they are seen from some distance, they have exactly the appearance of rocky islands in the midst of the ocean *.

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[*] Sungum signifies the angle of land formed by the junction of two rivers.

[†] Consult the Map in the last number of the Journal, and the section in this Number. Owing to the exact boundaries of the different formations not having been ascertained, they could not be coloured on the Map; and their *general situation*, therefore, has only been inserted.

The hills have very often a mamillary form; their sides being bare and smooth, and having generally large detached plates resting upon them, which appear as if they would the next moment slide down the smooth surface into the plain below.

The valleys are irregular, are strewed over with fragments and immense rolled masses of granite, and sometimes afford the most picturesque scenery. Notwithstanding the barren nature of granitic soil, the country is, in many places, covered with jungle †.

Upon a superficial examination, the granite of India might be pronounced to have several distinct structures, such as the stratified, tabular, columnar, &c.; but all of these may (I am convinced, from pretty extensive observation) be referred to the laminar; the laminæ giving rise, by the infinite variation in their direction, form, thickness, extent, and mode of disintegration, to the different appearances alluded to. The most common variety appears to be the curved laminar; the laminæ varying in their thickness from a few inches to many feet, and almost infinitely in the degree of their curvature. The bare mamillary shaped hills and knolls, which are so common throughout the granitic tracts of India, owe their origin to the curved laminar structure of the granite. They have almost invariably loose angular plates resting on their sides, which have arisen from the most superficial of the laminæ having split, and separated from those beneath ‡.

* Some of the strongest forts in India are of this description, for instance Chittledroog, Gooty, Copaldroog, Eidgheer, &c.

† Several species of custard apple *(Annona)* grow in great abundance in the jungles of Hydrabad; and even, in the driest season, their fruits attain great perfection

‡ Bellaryhill, some of the hills at Anagoondy, and Moul Alley hill, near Secunderabad, are good examples of these appearances.

The laminæ are sometimes straight, but seldom to a great extent; for if traced to a short distance, it will generally be found that they soon lose their straight direction, and become curved. These straight laminæ (as might be expected) vary in their dip, from horizontal to vertical.

The granite, on one side of a small hill at Shawpore near the Beema, has somewhat the appearance, when seen in a certain direction, from a little distance, of being columnar; but when it is examined more closely, it becomes evident that this appearance arises from the following circumstance. The laminæ of the granite, on that side of the hill, are straight and vertical, and had formerly made a very rapid curve at the top. By the influence of the weather, the curve had been worn away, and had thus allowed the inferior vertical parts of the laminæ to separate a little from each other; and, accordingly, when seen transversely, they have somewhat of a columnar appearance. This will be better understood from the diagram. Plate IV. Fig. 2. *a*, represents the small hill, *b* the vertical laminæ, which make a rapid curve at *c*; and this curved part of the laminæ, represented by the dotted lines, having been removed, the vertical portions have lost their support, have separated a little, and thus present, at their edges, the columnar appearance alluded to.

The laminæ of the granite are very often divided by natural joints or seams, which, in some instances, give rise to an obscure prismatic structure. These seams becoming widened by the action of the weather, and many of the separate masses, owing to their more perishable nature, having been disintegrated and removed, many of the peculiar features of the granite, already described, are thus produced.

A very interesting variety of these seams is met at Chundergooty, on the north-western frontier of the Mysore country. A small range of low undulating hills is composed of the common curved laminar granite; the laminæ of which vary from several feet to a few inches in thickness. Parallel to the direction of the range, viz. south by west, the granite is divided by vertical seams, which maintain the most perfect parallelism throughout their whole extent; and thus, were we to leave out of consideration the laminar structure, they might be said to divide the hill into regular vertical strata. The superficial laminæ have, in many places, separated at the seams, and by exposing those below, have afforded a proof that the seams extend through the whole mass of the hill. A transverse section of the hill would afford an appearance like that represented in Fig. 2. Plate IV. This granite is, in some places, penetrated by small veins of quartz, which, on approaching a seam, leave their original direction, follow the course of the seam for a greater or less distance, and again abruptly leave it.

The two surfaces of the laminæ are often perfectly parallel; and when they are not of a great thickness, they can be very easily raised in slabs of any size, for architectural purposes. It is seldom, however, that they are of precisely the same thickness for any great extent; and sometimes this varies prodigiously within a very short distance. In some instances of this description, the granite loses its laminar appearance. Thus, when a lamina becomes very rapidly thinner, so that its two surfaces meet, it acquires the shape of an immense wedge, which is not unfrequently met with. In such cases, the term laminar is rather inapplicable. At the same time, it must be remembered, that these are extreme instances, which are connected by many intermediate links to the most perfect form of this structure. Although, therefore, we would not apply the term laminar to these cases individually, yet it is perfectly evident that it is quite accurate as a general term, applied to the prevailing structure of the granite of India; and that, when we analyse the various appearances which the granite presents, they may be all considered as varieties and modifications of this structure.

There are several instances, in the Hydrabad country, of huge natural columns, formed of four or five separate masses of granite, piled with great regularity on each other, with part of their surfaces accurately adapted. These, in some instances, occupy the summits of gentle hills; and from all the appearances connected with them, it is perfectly clear that the different masses continue to occupy their original situations. The following is probably the manner in which this curious appearance has, in many cases, originated. Suppose Fig. 4. Plate IV. to be a hill of laminar granite, it is evident that if the laminæ be liable to be split and disintegrated by the action of the weather, those parts which rest on the sides, and are represented by the dotted lines, would be more liable, from their inclined position, to be worn down, and to slide into the neighbouring valley, than that part which rests horizontally on the summit; and were the mass *a* to be left, it would protect the portions *b c d e* immediately below it, while the other parts were gradually disintegrated and removed; and thus a rude column, composed of a number of separate blocks *a b c d e* of granite, would be formed. As the different masses rest horizontally on each other, and have their surfaces (except where these have been much acted upon by the weather) accurately adapted to each other, we cannot for a moment suppose that they have been conveyed from a distance, and arranged in this manner merely by chance. On the other hand, we have every reason to conclude, that they are the slight remains of laminæ, the other parts of which have been gradually worn down all around them; and that they now stand as monuments of what the height and nature of these laminæ formerly were.

It is by no means uncommon to meet with a vein of quartz, felspar, or trap, passing from one loose block of granite into another, or from a hill into a mass, resting loosely upon its surface; which clearly prove that these continue to occupy the situations in which they were originally formed. Upon a superficial view, one is naturally led to suppose that the confused heaps of granite blocks are the result of some great convulsion of nature. But by merely tracing the small veins of quartz, felspar, &c. which traverse the granite from one contiguous block into another, and by attending to the accurate adaptation of some of the contiguous parts of these blocks, we can prove that a great proportion of them continue in their original situations; and that all the appearances of confusion which they exhibit, are the result of a partial and irregular disintegration. It is only in the valleys that transported masses are found. We have generally reason to conclude, that all the separate masses, on the sides and summits of the hills, continue to occupy their original places, however confused these may now appear.

We have no reason to suppose that all the granite which has been disintegrated and washed away, was of a hardness and durability equal to that of the masses left entire. Had this been the case, their destruction would have required a length of time, which our imagination cannot embrace. But, it is quite evident, that the perishable granite of loose texture, which is so very common, has alone been removed; and this removal, by depriving the more solid masses of its support, has caused many of them to split, and be precipitated into the neighbouring valleys.

The distribution of the perishable granite is often very irregular; and, in this case, when removed, it must necessarily leave the solid masses with which it was associated in the most fantastic situations; and thus we can imagine how many of those appearances of confusion met with in the granite of India may have been produced. We can sometimes perceive how the original laminæ might be renewed, by filling up the void spaces between the different masses, and thus connecting together what were formerly distinct portions of the same lamina.

In regard to the mineral composition of the granite, it may be said (speaking very generally) to consist of felspar, quartz, mica, and hornblende; but it is very seldom that all these ingredients are found associated in one specimen. Sometimes one ingredient, sometimes another, is wanting, which produces a very great number of varieties. By far the most common is that composed of quartz, felspar, and hornblende,—the Syenite of Werner. The felspar is in some instances white, in others red. A great part of the Indian Peninsula, therefore, consists of a rock precisely similar to that found in the famous quarries in Egypt, and it has the same geognostical situation; for we are told by Daubuisson that the latter, like the Indian rock, is associated with granite *.

The ingredients vary very much in their proportions and colour; and thus produce varieties that occur within a short distance of each other, in the same lamina. One variety is sometimes found passing imperceptibly into another, penetrating it in the form of a vein, or imbedded in the form of a nodule.

A very interesting variety is found associated with the granite at Roan, in the Darwar district †. It consists of a very dark red felspar, with small disseminated crystals and minute

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* Traité de Geognosie, tom. ii. p. 20.

† I am indebted to Walter Elliot, Esq. for the specimens of this rock which I possess.

veins of quartz; and, what is curious, there are numerous small vesicular cavities throughout the felspar, some of which are lined with very minute crystals, apparently of chlorite. It would be interesting to ascertain the exact relation which this rock bears to the granite, a point which I myself had not an opportunity of examining.

A very beautiful rock is found associated with the granite at Gudjunderghur. It is a sort of greenstone porphyry; the basis being greenstone, and containing large crystals of red felspar.

The Indian granite is generally small granular. I have only seen one specimen of large-grained granite in India, which had been brought from Mysore, and was composed of felspar, quartz, and mica.

At the Falls of Garsipa there is a variety of granite, which differs from the common granite of India. It is not so old a granite as the latter; is composed of small grains of white felspar, quartz, and mica; has, in some instances, a slaty appearance; and is associated with gneiss and hornblende schists. These rocks, being perfectly bare, can be very easily examined. They all occur within a space of a few hundred yards. I observed several varieties of the hornblende rock. One consists almost entirely of hornblende; a second contains disseminated crystals of felspar; a third contains mica and felspar; a fourth has more of the characters of actynolite than hornblende; and a fifth contains so much mica, that it appears to be almost entirely composed of it. All these varieties, with the gneiss and granite, pass insensibly into each other. They are distinctly stratified; have a dip of about 30°; and their direction is nearly ESE. They form the sides of the chasm, over which the river is precipitated at the Falls of Garsipa; and the depth of which, as already stated, is nearly 1000 feet. This is the only place in India where I have met with primitive gneiss; but it is not improbable that it occurs in many other parts of the country. We are told by Dr Davy, that the greater part of Ceylon is composed of it *; and it is also found in the Hymalayas †.

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* *Vide* Transactions of the Geological Society of London, vol. v. p. 314.

† *Vide* do. do. New Series, vol. i. p. 132.

Quartz veins are very common in the granite. They are sometimes so small as to be capable of being exhibited in hand specimens. Sometimes they are of such a magnitude as to form ranges of hills, which may be recognized at a great distance by their white colour. Those hills appear to have originated from the indestructible nature of the quartz having enabled it to withstand the attacks of the weather; while the more perishable granite was worn down all around it. There are two conspicuous ridges of quartz which appear to have been formed in this way, in the vicinity of Hydrabad. One is near the British native cavalry lines; the other is near the town of Shumsabad. Drusy cavities, lined with very beautiful amethysts and rock-crystals, are sometimes found in these hills. The granite, in the vicinity of these veins, often passes gradually into the quartz, by losing its other two ingredients.

Trap is very common throughout the granite tract of India. It is found both in veins and in extensive overlying masses.

The veins which traverse the granite, present two distinct kinds of trap. One is precisely similar to the most common kind of the secondary or overlying trap, viz. a greenstone of a perishable nature, and having a concentric lamellar structure. It therefore most probably belongs to that formation. The other is more compact, has a rhomboidal structure, occurs generally in smaller veins, and is much more durable.

Large accumulations of granitic debris are met with all over the granite tracts of India. In many places this debris has so completely consolidated, simply by means of the aggregation exerted between its particles, as to form a hard rock *. This rock, in some instances, exhibits an obscure schistose structure.

Granite is not generally employed as a building stone in India, on account of its great expence; but large slabs of it are sometimes brought into the bazaars for sale by the Wudrahs †, and are used for paving the floors of the verandahs in the bet-

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* Kirwan mentions an instance of *an artificial* accumulation of granite sand having so completely consolidated, by means of a simple aggregation between its particles, as to form a rock so hard as to be impenetrable by water.

† A vagrant class of people, somewhat resembling the gypsies.

ter sort of native houses, and other similar purposes. It is also hewn into hand-mills, for grinding corn; two or four of which are a load for an ass or a bullock; and are thus carried to the bazaar for sale*. These are the primeval mills of all countries, which are mentioned in Scripture, and are still common among all uncivilized nations.

The ancient Hindoo temples at Anagoondy, now partly in ruins, are built of grey granite, or rather syenite. The massive and gloomy style of architecture which characterises all Hindoo buildings, is also met with here; but, in one instance, it has, to a certain degree, been departed from; for, in one of the principal buildings, there is an extensive colonnade, the columns of which are light, with small pedestals and capitals, and approaching somewhat in their proportions to the Grecian. Some of the pillars are tastefully carved with flowers. A few are in the form of caryatides. They support immense slabs of granite, which are carved on their under surface, so as to form an ornamental roof. The largest of these slabs, which are in the central part of the building, are at least thirty feet long †. The laminar structure of the granite has probably been taken advantage of in the formation of these slabs; for a slab of almost any thickness may be easily detached from its native situation, and then cut into the required form, and of the necessary length and breadth.

It would appear, from a paper by Dr Kennedy, in the 8th number of Brewster's Journal, that the natives of India have a method of polishing granite, which communicates to it a black colour. In this, I am pretty sure, he must have been deceived, and that he has mistaken trap for granite. Trap is extensively used in India for architectural purposes, and for statuary. Most of the temples at Anagoondy, as already mentioned, are built of grey granite, which perfectly retains its natural colour. Some, on the other hand, are built of greenstone, and are consequently black.

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* This brings to mind the following passage of Virgil:—

> "Sæpe oleo tardi costas agitator aselli,
> Vilibus aut onerat pomis: *lapidemque revertens*
> *Incusum*," &c.

† I cannot positively state their exact length; for I attempted to ascertain it simply by pacing across the building: but I am confident they are not less than thirty feet long.

The Hindoos polish all kinds of stones by means of powdered corundum, mixed with melted lac. The mixture being allowed to cool, is shaped into oblong pieces, of three or four inches in length. The stone is polished by being sprinkled with water, and at the same time rubbed with these oblong masses; and the polish is increased by masses being used successively with finer grains.

### *Transition Rocks.*

These rocks occupy a very large part of the Darwar and Canara districts, and of the territory of Goa. They extend from the eastern and southern parts of the Darwar district, where they succeed the granite, to the western foot of the Gauts, being, in a few spots only, interrupted by the granite, which protrudes from beneath them. On the coast, they are concealed by the ferruginous claystone; but, in a few places, are seen cropping out from beneath it. In some parts of the Gauts they are covered by the same claystone, and by trap rocks. In the northern parts of the Darwar district, they are only seen in the bottom of the valleys, which intersect the sandstone hills. In the central and southern parts of the district they are only covered by the black soil, called Cotton Ground, which there forms extensive plains, and will be afterwards described. To the west of Darwar the transition rocks form parallel ranges of hills, having a general direction of south-east, which is the same as that of the strata of which they are composed.

The principal rocks of this series are clay-slate, chlorite-slate, talc-slate, limestone, greywacke, gneiss, and quartz rock. The strata appear to have a general direction of north-west and south-east. They are generally highly inclined, and, in many instances, quite vertical.

*Clay-Slate.*—A great many varieties of this rock are met with in these districts. Its principal colours are grey, blue, greenish, red, and white. The grey variety appears to be the most common. I have met with it near Kulladghee, a few miles from Darwar, at Hoolgoor, along the river Mulperba, and in Soonda. At Kulladghee it contains beds of white quartz, in which I found specimens of copper-green. It has sometimes a greenish colour, and a blue variety is occasionally associated with it, which very much resembles roofing slate; but has seldom its hardness. It is also associated, in some places, with a rock closely resembling the greywacke slate of the south of Scotland.

The red and white varieties of the clay-slate occur in very considerable abundance in these districts. They extend for several miles around Darwar, where they are associated with quartz rock. They are found a little to the north of Kulladghee; and I met with them also near Holvully in Soonda. They may be said generally to consist of felspar, more or less coloured with iron, and having a loose aggregation. Some varieties, however, are intimately mixed with quartzy particles; which gives them a great degree of hardness; and they thus gradually pass into the quartz rock with which they are associated. The white variety is frequently so pure, that, in hand specimens, it would at once be pronounced to be a pure porcelain earth. This variety is found in great abundance at Darwar; and it might, I have no doubt, be very advantageously quarried for the purpose of being manufactured into porcelain ware. It has an obscure slaty structure. The red varieties with which it is associated, are distinctly slaty. There is a gradual transition from the purest white kind, to those having a deep red or brown colour. A light purplish colour is also sometimes met with.

At Darwar, these rocks are distinctly stratified. The strata are nearly vertical; and their direction is north-west and south-east. No single variety forms a continuous bed of any extent; but, on the contrary, several varieties are often found within a very short distance of each other, in the same stratum; and they are almost always traversed by thin veins of a brown quartz. In addition to the strata seams, these rocks are generally traversed by other parallel seams, which cross the strata, and thus, in some instances, give rise to large rhomboidal masses. So parallel and distinct are these transverse seams, which are seen in some of the large wells at Darwar, that they might, on a superficial view, be readily mistaken for the true stratification.

Owing to the soft nature of these clay-slates, wells can be very easily dug at Darwar; and several that were dug, during my residence there, to a depth of at least seventy feet, afforded me opportunities of studying the nature of the strata. Sometimes the red, sometimes the white, variety occurs at the surface; and I have found the latter at a depth of seventy feet. Some of the varieties, when weathered, assume an ochre yellow colour.

A fine display of these varieties of the clay-slate occurs in the bed of a ravine near Kulladghee. They there alternate with beds of greywacke. They have a very highly inclined, and, in some places, a vertical dip; and their direction is about north and by west, south and by east. In the dry season they can be very easily examined; for they are completely exposed for an extent of probably a quarter of a mile, except in a few spots where they are covered with debris. In those parts of the ravine where they have been worn down and polished by the stream, their red, blue, and white colours produce a beautiful appearance.

*Chlorite-Slate.*—This rock is very widely distributed throughout these districts. It is met with throughout the whole of the central and southern parts of the Darwar district, in the Gauts, and at several points on the western coast, under the claystone conglomerate. Its most common colour appears to be light greenish-grey. In the Ram-gaut, I found it with disseminated grains of felspar, and having a fine slaty structure. There is a variety found near Darwar and Kittore, which is intermediate between chlorite-slate and clay-slate. It has a bluish-grey colour, a slightly greasy feel, is hard, and has a coarse slaty structure. When tolerably compact, it is employed as a building stone; for which it is well adapted.

Some varieties of the chlorite and clayslates contain crystals of iron-pyrites. I have been informed that this mineral is sometimes sent all the way to Madras, by the native merchants, as an article of trade, I believe for the purpose of being cut into beads and other ornaments used by the natives.

*Talc-Slate.*—This, like the chlorite slate, has a very wide distribution throughout these districts. There are several varieties of it. The talc sometimes occurs unmixed with any other substance. It has, in this case, a fine slaty structure, and a greyish or reddish colour. This variety I found a few miles from the Falls of Garsipa. Most frequently the talc is mixed with quartz; and the rock has then the general appearance of mica-slate, excepting the difference in the characters of the two minerals. This variety occurs in the central parts of the Darwar district, and in the Western Gauts. At Nurgoond and Chick Nurgoond, the strata of this variety have a nearly vertical dip; and their direction is south-east and by south.

Potstone is found associated with these rocks in the south-east part of the Darwar district; and is used by the natives for the manufacture of various utensils. The Soapstone, which is sold in all the bazaars, is probably also obtained from the same formation; but I myself have never seen either it or the potstone *in situ* *.

All the fine plaster with which the walls of the houses are covered in India, and which is so much admired by strangers, is composed of a mixture of fine lime and soapstone, rubbed down with water: when the plaster is nearly dry, it is rubbed over with a dry piece of soapstone, which gives it a polish very much resembling that of well polished marble.

*Limestone.*—I have met with limestone only in the north-east parts of the Darwar district. Numerous large beds of it occur about Kulladghee and Bagulkote, where it is associated with clayslates and greywacke. Its strata are highly inclined, and their general direction appears to be north and by west, south and by east. The principal colours of the limestone are yellowish grey and blue; more rarely it approaches to white. Its fracture is generally flat conchoidal. One of the varieties, from near Bagulkote, answers well as a lithographic stone; for which purpose it has been used at Bombay.

*Greywacke.*—This rock, as already stated, is associated with the clayslates and limestone at Kulladghee; it also occurs in some other parts of these districts. Most of the coarse greywackes there have not the hardness that usually belongs to the same rock in Britain; but, on the other hand, they partake of the loose aggregation of the clayslates with which they are associated. I have met with *greywacke slate* on the Mulperba, and in the southern parts of the district.

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* I am indebted to Walter Elliot, Esq. for the specimens of potstone which I have, and which he took directly from the quarries.

*Gneiss.*—All the transition gneiss that I have met with in the Darwar district was weathered; and, at first sight, therefore, it closely resembled a loose sandstone. It occurs in large quantities at Dummul; and beds of it are also met with at Nurgoond, associated with talc slate.

*Quartz Rock.*—Beds of quartz are found among all the other transition rocks in these districts; and, in some instances, they are very large. It also occurs in all of them in the form of veins.

In the whole of that tract of country, extending from Darwar to beyond Kittore, and which is characterized by its parallel ranges of hills, the quartz occurs in large beds, which are almost invariably found forming the summits of these ranges. This circumstance enables us to account for the hills being parallel to the strata of which they are composed; and, consequently, to each other. The durable nature of the beds of quartz has caused them to resist the attacks of the weather, while the soft clay-slates with which they are associated have gradually given way. The valleys have thus been scooped out between the parallel beds of quartz rock, which we find forming the summits of all the hills; their flanks and the bottoms of the valleys consisting of the softer and more perishable clayslates. The hypothetical section, fig 5, Plate IV. will probably afford a clearer conception of this arrangement.

The quartz of which these beds are composed, is in general deeply coloured with iron. Some varieties, however, have a grey colour, a splintery fracture, and closely resemble hornstone. It has often a uniform brown colour; and some specimens contain so much iron, as to increase considerably their specific gravity. In many instances, the base of the rock is white or grey; and is traversed in all directions by dark brown coloured veins highly impregnated with iron. But, in some specimens, the dark brown variety is in much larger quantity than the white basis; and then the latter appears as if it had been broken into a number of small angular fragments, which had been afterwards united by the consolidation of the brown variety from the fluid form. This variety contains numerous small cavities, which are lined with red hæmatite, in the shape of stalactites, or having a blistered or mamillary form. The cavities are generally very small; but I have seen very large specimens of red hæmatite, which were found in the Kupputgood Range. Brown hæmatite is also sometimes met with; but it is not so common as the other.

I may here mention, that I found a large bed of a variety of compact magnetic iron-ore, on the summit of a small hill, near Hitnal,* a village in the Hydrabad country. It is associated with mica-slate, and quartz rock; and the base of the hill consists of granite.

### *Old Red Sandstone.*

This is one of the most extensive formations in India. It forms the summits of most of the eastern Gauts. It extends over a great part of the district of Cudapah; occupies extensive tracts in the Decan; forms the summits of most of the hills in the Vindhya and Gondwana ranges on both sides of the Nerbuddah; and extends over part of Bundelcund, and even as far as Delhi.

The old red sandstone occupies a large tract of the districts, the geology of which forms the subject of this paper. From Gudjunderghur, where it rests immediately upon the granite, it extends north, and north-east, as far as the Kistnah, occupying all the north-east corner of the Darwar district, and extending some way into the Hydrabad country. From thence it stretches across the country to beyond Gokauk, occupying all that tract which has been already pointed out in a former part of this paper. It also forms the summits of three insulated hills in the centre of the district, viz. the hills of Noulgoond, Nurgoond, and Chick Nurgoond. On all of these three hills, it forms large tabular masses, the sides of which form mural escarpments all round; and, from the bottom of these escarpments, the hills have a gradual slope to the plain below. At Noulgoond the sandstone rests on granite; on the two latter hills it rests on the talc slates of the transition class.

From Gudjunderghur to Badamy, and in all the hills south of the Mulperba, the strata of sandstone are almost universally horizontal. The hills are all very nearly of the same altitude, are in long ranges, having even summits, and, when seen from a distance, they look like huge natural walls. The sketch fig. 6, will give an idea of their general appearance.

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* Hitnal is about ten miles to the east of Copal.

North of the Malpurba, the strata of sandstone are in general more or less inclined; and they appear to rest there unconformably upon the transition rocks, viz. the clayslates, greywacke, limestone, &c.

In regard to its mineral composition and structure this rock varies exceedingly. It occurs under the forms of a coarse conglomerate, a coarse sandstone, and different varieties of compact quartz. Its most common colours are red and brown; and it is frequently variegated with white.

At Gudjunderghur, and in the hills which extend from that place to Badamy, it is in the form of a very coarse sandstone. It there consists, generally speaking, of grains of quartz, cemented together by means of clay. Sometimes the quartz is in large rounded or angular masses, thus forming a coarse conglomerate. Generally, however, it is in smaller grains of uniform size, forming a coarse sandstone. Its general colour is red. Sometimes it is variegated with white; the white being in patches, or in straight or waved lines; and I have seen large round nodules of white imbedded in the red base.

To the north of the Malpurba the quartz, or compact variety, prevails. It has a splintery fracture and brown colour. In many instances it is traversed in all directions by white veins. It is, in many places, associated with puddingstone, which occasionally forms very large beds. In the hills of Nurgoond and Chick Nurgoond, both the arenaceous and compact varieties are found very near each other. In one part of the latter hill, the compact variety has, on the large scale, somewhat of a spheroidal structure. In the south-east part of the Nurgoond Hill there is a large mass of a diaphanous quartz with a bluish colour, and disseminated grains of felspar. This variety is by no means uncommon, especially in the hills south of Kulladghee, where it has sometimes a reddish or white colour.

Some geologists might be disposed to arrange this sandstone with the old red sandstone of English geologists (transition red sandstone of the Germans); but I am inclined to consider it identical with the old or new red sandstones of the Wernerian geognosy; and, therefore, as very generally disposed in an unconformable position in regard to the transition rocks. I will now, therefore, state, as briefly as possible, the circumstances upon which I rest this opinion.

*First*, In many parts of the Darwar district the sandstone hills have horizontal strata, level summits, and, for many miles, exactly the same altitude; while at one part we find granite, at another part transition rocks, immediately at their bases.

*Secondly*, On the south-east declivity of the small hill of Chick Nurgoond, the schists are not covered by debris. Their dip is vertical, and their direction nearly north-west by west. They can be traced to within a few feet of the sandstone, which forms the summit of the hill, and which dips towards the north-west, at an angle of about 40°.

*Thirdly*, A small range of sandstone, or rather quartz hills, near Kulladghee, is divided in several places by ravines. In walking up one of these ravines, you have the quartz hills on both sides, and can observe their strata inclined at a small angle, while the bed of the ravine along which you walk consists of the clayslates and greywackes, which are found in all the low parts of the adjoining country, and the strata of which are mostly vertical.

I have never seen the sandstone conformable to the transition rocks; but I do not mean to say that this may not sometimes be the case. The above observations however, are, I think, quite sufficient to shew that it is very often unconformable, and may belong to one or other, or include both the red sandstones of the Wernerian geognosy.

The following striking appearances are presented by the sandstone of Badamy. The hills at that place, composed to their very bases of sandstone, have perfectly even summits, and are surrounded on all sides by vertical precipices, descending, in many instances, completely to the valley, which is covered with fine sand, the debris of the adjoining hills. The sandstone strata are generally horizontal. The precipices have a height of probably two hundred feet *; and the hills are, in many places, completely divided by rents from top to bottom, and are thus separated into a number of huge distinct masses. Some of these masses which are next to the plain, have a slight inclination forwards, and appear as if a very slight force would be sufficient to occasion their complete degradation.

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* I state this only from memory; it must therefore be considered merely as an approximation.

The two small forts of Badamy are built upon these precipitous sandstone hills. Next the plain these forts are protected by a precipice of two hundred feet; and, on the opposite sides, they are defended by deep rents, which separate them from the adjoining parts of the hill. The only access to the forts is up through the rents already mentioned. Upon entering these at the bottom, you have on each side of you immense walls of rock, from one to two hundred feet high, and affording a passage of only a few feet in width. The rents are less deep as you advance; and the ascent is generally by means of steps cut in the solid rock.

A cave, the roof of which is supported by pillars, and the sides carved with representations of some of the Hindoo deities, is excavated in the sandstone of Badamy. It is not, however, to be compared, in point of size, with the caves of Elephanta or Ellora.

## *Secondary Trap Rocks.*

Trap rocks occur very extensively in different parts of India. They are met with in some parts of Mysore and Hydrabad. They occupy a very large part of the Decan, extend from near Fort Victoria on the western coast northward beyond Bombay, stretch thence across the country through Kandeish into Malwa; and are also met with in Bundelcund and Marwar *.

In the Darwar district they do not occur in great abundance. The great formation of trap, which extends all the way from the northern parts of the Decan to the south of the Kistnah, terminates here; and the trap hills to the south and east of Belgaum probably form its boundary in that direction. It is therefore in the north-western part of this district that the trap is principally met with. I must also mention, however, that I found a compact greenstone at Sedasheghur resting upon granite; but I am inclined to think that it does not belong to the secondary trap which we are now considering, but to a much older formation.

The trap in the neighbourhood of Belgaum forms rounded hills, and does not exhibit the appearance of steps of a stair, which characterizes the trap in other places. It is also found in the form of veins traversing granite, in some parts of the Hydrabad country. A very large vein of secondary greenstone is found traversing the granite at the village of Mussaputtun, near Anagoondy. It is so large as to form a small range of hills, which, being nearly bare, can be recognised at a great distance by their black colour.

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* Vide Mr Fraser's paper in the first volume of the Geological Society's Transactions, New Series.

The most common rocks which occur in this extensive formation are, a loose greenstone, basalt, and amygdaloid. The first, which appears to be the most common, has a concentric lamellar structure, the lamellæ separating very easily from each other, and becoming harder towards the centre, which contains a hard nucleus. Sometimes this variety has a rhomboidal structure; but, in this case, each rhomboid is found to have the concentric lamellar structure in its interior. This greenstone is almost always weathered to a very great depth. It is, therefore, very difficult to get a fresh specimen. When weathered, it has a grey colour; when fresh, it is found to be composed of distinct grains of felspar and hornblende.

The compact varieties of greenstone are very much employed in India as building stones. Most of the magnificent mosques and mausolea at Beejapore, which is situated in the midst of the trap formation, are built of it.

I found basalt at the village of Baugwarry, twelve or fifteen miles east from Belgaum. It contains small vesicular cavities, which appear never to have been filled with any substance.

I have never seen the amygdaloid *in situ*; and it does not appear to be common in the Darwar district. Specimens of it have been brought to me from the neighbourhood of Beejapore. They contain zeolites, green earth, and calcareous spar; and resemble the same rock in Britain.

## *Ferruginous Claystone.*

This is the Laterite of Buchanan. It covers very large tracts, both in India and the neighbouring countries. It extends all along the western coast, from Fort Victoria to the southern extremity of the Peninsula*. It occurs in great abundance in the Decan, in Mysore, in the district of Cudapah, and in Orissa.* It is met with also in Ceylon; and is almost the only rock which occurs in Malacca.†

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* Vide Mr Calder's paper in the Asiatic Journal for October 1828.

This rock may be described, generally, as consisting of claystone, more or less impregnated with iron, and having a massive, perforated, or cellular structure. It frequently contains, imbedded in it, small masses of clay, quartz, or ironstone. In its native beds, a short way under the surface, it is so soft that it can be easily cut with a hatchet or spade; and, when sufficiently compact, and not containing imbedded portions of quartz, &c. it is cut into square masses like bricks, and is used as a building stone. Hence Buchanan gave it the name of Laterite; and its names, in the native languages, are derived from the same circumstance. When these square masses are exposed to the air for some time, they become very hard; and, when not exposed to constant moisture, they answer admirably as building stones. Most of the handsome Roman Catholic churches at Goa are built of this claystone or laterite. In the principal fronts of these churches it is covered with plaster; but, in other parts, it is left bare, and completely retains its hardness when exposed to the atmosphere.

The ferruginous claystone occurs in different parts of the Darwar district; but principally in the western parts, and on the summits of the Gauts. Scarcely any other rock is seen in the Goa territory, and it extends almost uninterruptedly from Goa to Honoor. It is found resting in different situations, on granite, transition rocks, trap, and sandstone. It is a very curious and interesting circumstance in regard to the geognostical situation of this rock, that it is found resting upon granite and transition rocks along the coast, and is again found resting upon the same rocks at the summits of the Gauts, at an elevation of several thousand feet ‡. It forms, along the coast, a succession of rounded hills; and, towards the sea, it generally presents mural precipices. I have never seen beds of any other rock alternating with it; and it is no where stratified. Sometimes it forms table-shaped masses on the summits of the Gauts; and, where it is split into separate masses on the coast, these have sometimes an obscure cubeidal form. It may be said, however, to have no distinct structure, and merely to form enormous overlying masses, which extend over a very large part of the peninsula of India.

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* Vide Asiatic Researches, vol. xv. p. 177.

† Vide Finlayson's Mission to Siam and Hue, p. 37.

‡ Vide Section, fig. 1.

In some places the claystone contains numerous small nodules of clay iron-stone, which seldom exceed the size of a walnut. These are picked up by the natives, and are smelted by means of charcoal in a very small rude furnace, blown by the hand-bellows, common all over India, and still used in Europe by the Gypsies. If any profit can be obtained from such a very rude and tedious process, to what good account might not the rich ores of hæmatite and magnetic iron be put?

Many of the hills composed of this rock are nearly devoid of vegetation; their surface being bare and smooth, and of a red or black colour. The soil produced by its disintegration is not very productive; and so liable is it, in some places, to consolidate, when deprived of its mosture, that, if it be not constantly cultivated, it soon becomes hard and bare, and checks all vegetation.

I have seen no secondary rocks in India above the old red sandstone, except the trap and ferruginous claystone. Dr Adams mentions, that he found rolled pieces of coal in the bed of the Towa river, which falls into the Nerbudda*; but he did not see the coal *in situ*; and the existence of the coal formation, therefore, in the peninsula of India, still forms an interesting subject of enquiry for future observers.

### *Cotton Ground.*

Immense deposites of a black alluvial clay are met with in various parts of India. It is denominated cotton ground, from the circumstance of that plant being always cultivated upon it. It is the regur soil of the ryuts. It forms large plains throughout the whole of the Decan; some of them sufficiently extensive to bring to mind the descriptions given by travellers of the Pampas of South America, or the Steppes of Russia.

Its depth extends from two or three to twenty or thirty feet. Its colour is greyish black or brownish black. In many places it is perfectly unmixed with any foreign ingredient. In other instances it contains nodules of calcareous tufa †, agates, calcedony *, and occasionally also zeolites. In the hot season, it is every where traversed by deep fissures; which, in some cases, have a great appearance of regularity, like that observed in dried starch; but most commonly they are perfectly irregular. The late Dr Voysey, when at Hydrabad, subjected some of this clay or cotton ground to the heat of a steel furnace, which fused it into a black glass.

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* Vide Memoirs of the Wernerian Society, vol. iv. p. 61.

† This substance is well known by the name of Kunkur in India.

The black colour of this clay, the carbonate of lime, agates, and zeolites found in it, and its conversion into a black glass by heat, all indicate that it has originated from the disintegration of trap-rocks. The extensive distribution of the trap-rocks makes this inference still more conclusive. The soil which covers the trap-hills, and which we are certain has originated from the disintegration of the subjacent rock, exactly resembles the cotton ground of the extensive plains. Were this cotton ground to be again consolidated, it would form an immense overlying formation of a substance resembling basalt or wacke. Its very great importance in the agriculture of India will be considered hereafter.

Several deposites of calcareous tufa occur in the Darwar district. There is one of considerable extent near Badamy. It is covered by the soil, and appears to rest upon the transition rocks. Sometimes nodules of calcareous tufa are found disseminated through the cotton ground, and materially affect its agricultural properties. From its being thus associated with the cotton ground, I think it is highly probable that the calcareous tufa has, in many instances, owed its origin to the calcareous spar of the trap-rocks, of those rocks the debris of which now forms the cotton ground. The tufa is used for the preparation of mortar.

In concluding these observations, I have much pleasure in expressing my acknowledgment to Professor Jameson for having corrected some of my observations, and for his valuable remarks upon my specimens of the rocks of the Southen Mahratta country.

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* The same circumstance is noticed by Dr Adams in regard to the black soil of the Nerbudda valley. Memoirs of the Wernerian Society, vol. iv. p. 52.

*(To be continued.)*

## *Barometric Measurement of the Height of Ben-Lomond, and on the Quantity of Water annually discharged by the River Leven, from the Basin of Loch-Lomond.* By Mr WILLIAM GALBRAITH, A. M. (Communicated by the Author.)

DEAR SIR,

IN a former number of this Journal were inserted two tables, for the purpose of facilitating barometric measurements, which form a part of a series drawn up by me with that view, and will appear in a new edition of my Mathematical Tables, now in the press. By means of these, I had some hopes that greater accuracy would be attained than usual, by this method of determining the heights of mountains; and was desirous of ascertaining this fact in a satisfactory manner, by a direct appeal to observation. I mentioned this proposal to my friend Mr John Adie, optician, who cordially entered into my views, and provided two very excellent mountain barometers of the best construction. They were of the kind called syphon barometers, their cisterns were provided with an apparatus for complete adjustment, by which means the effect of capillary action was obviated, and their verniers shewed the height of the mercury in the tubes, when read by microscopes, to one thousandth part of an inch. Before applying them to the measurement of any height, their index errors were uniformly determined with great care. There were also attached thermometers set in the brass tubes surrounding the glass, the bulbs of which were bent so as to approach the barometer tube rather closely, that the mercury in the ball of the thermometer and barometer tube might be equally affected with changes of temperature.

One considerable difficulty has always attended barometric measurements, namely, the quantity of aqueous vapour mixed up with the air at the time of observation, the effects of which on the resulting height are known to be considerable. In the 24th and 26th Numbers of the Edinburgh Philosophical Journal, Dr Anderson, of the Academy of Perth, treats this subject with considerable address; and, from experiments that he had made, found differences of 40 or 50 feet in 1000 feet, even when the formula of Laplace was employed, though this formula was very accurate, when the air was in a mean state with regard to humidity. The Doctor proposed to find the effects of aqueous vapour, by means of two thermometers, one of which had its bulb covered with tissue paper, and then by a formula, depending on experiment and observation, he deduced the dew point. The difference between the temperature of this point and that of the atmosphere, gives the means of ascertaining the quantity of aqueous vapour present at the time, and its consequent effects on the height of any mountain deduced barometrically.

This method, however, is not so simple as could be desired, and recourse has frequently been had to other methods, such as the hygrometer of Mr Daniell. Mr Daniell's hygrometer, however, is an instrument rather inconvenient, both from its complex construction and from its bulk, and the quantity of ether requisite for a series of experiments.

On this account, Mr Adie has turned his attention to the subject; and has, it is believed, succeeded in constructing an instrument, at once simple in its form, easy in its application, and accurate in its results. It will be fully described by himself, in a paper which he intends to draw up for that purpose, containing a comparison with Mr Daniell's.

I shall only observe, that the instruments used here consisted of a thermometer, of which the ball is of black enamel, covered with cotton or linen cloth, except a small portion in front; and then the cloth is attached to the glass by a species of size or gum. On this part the deposition of the dew is formed, when cooled sufficiently, by pouring comparatively a small quantity of ether upon the cloth; and the eye, after a little practice, very readily catches the first appearance of dew, and easily marks the temperature, as it remains steady for some time. With these instruments all our observations were made; and the graduations on this last corresponded also with Fahrenheit's scale.

Observations with the barometer are generally made by two individuals, one at the top of the mountain, and one at the bottom, at the same time, that time being known by signal, or by being previously agreed on. As we were desirous, however, to discover, whether corresponding observations, made at a considerable distance, were to be depended on equally with these made in the immediate vicinity of the mountain of which the height is to be determined, two observers readily agreed to make corresponding observations in the vicinity of Edinburgh, at the same time that Mr J. Adie and I were employed at Ben-Lomond.

Of these our friend Mr Thomas Henderson made regular observations with the barometer, on the Calton Hill, the cistern of which is nine feet six inches above the floor of the observatory, and, from previous observations, 355 feet above the mean height of the sea at Leith.

In order to obtain the utmost accuracy, it was thought necessary to determine the correct barometric coefficient, according to the circumstances of the case, rather than to take a mean, which has been generally adopted. Ramond, on comparing a great number of heights, determined barometrically with the same, geometrically found the general coefficient at the level of the sea to be 18,336 French metres; while M. Biot found, by comparing the specific gravity of air and mercury, that it is 18,334 metres at the parallel of 45° N. The mean of these is 18,335 metres, equal to 60,155 feet, or 10,026 fathoms, at the freezing point, or 32° of Fahrenheit's scale. It may be remarked, however, that M. Biot supposes the mean height of the lower barometer, in his Tables for Computing Barometric Heights, to be 1200 metres, or about 4000 feet above the sea; and the higher barometer 2000 metres, or about 6500 feet above the lower, or 10,500 feet above the sea; and these suppositions, allowing for the difference of gravity, according to their heights, give 18,393 metres, equal to 60,346 English feet, or 10,058 fathoms, for the general coefficient, which he thinks sufficiently accurate for ordinary barometric purposes. This is no doubt true, and it is not likely that such operations will ever possess the same extreme precision as those of astronomy; yet it is probable, I think, that they may be much more accurate than at present, if we consider the great superiority which the modern methods possess over those of De Luc, Roy, &c. At all events, a table of correct barometric coefficients is almost as easily applied as the mean one in a great range, obviously in both extremes incorrect, and consequently the former has been preferred in our calculations.

After comparing our barometers at the Observatory, Mr J. Adie and I set out, on the 25th of August 1828, on a short tour, by way of Stirling, Callander, the Trosachs, and Loch Cathrine, so as to combine a little amusement with our more important pursuits, and without interfering with their necessary accuracy. Indeed, if a few of the more generally useful instruments of that kind were always carried by our scientific travellers, the accumulation of important facts, and valuable materials, conducive to the progress of general knowledge, would be greatly increased.

The barometers were marked, A, B, C, and D, and, taking A as a standard, the mean index errors were as follows:

| A | B | C | D |
|---|---|---|---|
| Inches. | Inches. | Inches. | Inches. |
| 0.000 | —0.033 | +0.021 | —0.015 |

On the 27th of August 1828, at about 11 o'clock forenoon, with barometer A, I arrived at the Cairn, on the top of Ben-Lomond, in which is placed the pole erected by the Ordnance surveyors, which marked one of their stations.

I.—*Observations made with Barometer A, on the Top of Ben-Lomond, the Cistern being 2 feet under the extreme summit.*

| Times. | Height of Barometer. | Attached Therm. | Detached Therm. | Dew Point. | State of the Weather. |
|---|---|---|---|---|---|
| H. M. | INCHES. | ° | ° | ° | |
| 11 15 | 27.041 | 57.6 | 57.6 | 49.0 | Haze and fog, with a light wind at SW. |
| 25 | 27.048 | 58.4 | 59.0 | | |
| 35 | 27.056 | 59.5 | 59.5 | | |
| 50 | 27.060 | 59.8 | 59.8 | | |
| 12 0 | 27.063 | 60.5 | 60.5 | 50.0 | Fleeting clouds occasionally. |
| 10 | 27.064 | 60.0 | 60.3 | | |
| 20 | 27.063 | 60.4 | 60.0 | | |
| 30 | 27.063 | 59.8 | 60.0 | 49.0 | Rather clear, with thin clouds at times. |
| 40 | 27.064 | 60.2 | 60.0 | 50.0 | |
| 50 | 27.066 | 60.3 | 60.0 | | |
| 1 0 | 27.064 | 60.2 | 60.8 | 49.0 | |
| Means | 27.064 | 60.1 | 60.2 | 49.5 | |

On account of the gradual rise in the height of the barometer, from eleven to twelve o'clock, as well as from occasional interruptions from a company of ladies and gentlemen, who arrived at the top shortly after I had set up the barometer, and were desirous to know the use of my apparatus, which, of course, it was necessary to explain, it was thought proper to reject the observations made during that interval, and retain those only that were made between twelve and one o'clock, during which the barometer was almost stationary.

II.—*Observations made with Barometer* B, *by* Mr John Adie, *at Rowardinnan, near the Base of the Mountain, and* 2 *feet above the surface of the Lake, estimated at* 32 *feet above the Sea at Dumbarton, after rejecting those previous to* 12 *o'clock.*

| Times. | Height of Barometer. | Attached Therm. | Detached Therm. | Dew Point. | State of the Weather. |
|---|---|---|---|---|---|
| H. M. | INCHES. | | | | |
| 12 0 | 30.331 | 75°.5 | 75°.5 | 60°.0 | Weather as before. |
| 15 | 30.327 | 75.5 | 75.5 | 60.0 | |
| 30 | 30.325 | 75.0 | 75.0 | 60.0 | |
| 45 | 30.330 | 76.0 | 76.0 | 60.0 | |
| Means | 30.328 | 75.5 | 75.5 | 60.0 | |

III.—*Observations made with Barometer* C, *by* Mr Thomas Henderson, *at the Calton-Hill, Edinburgh. Height of Cistern* 355 *feet above the Sea at Leith.*

| Times. | Height of Barometer. | Attached Therm. | Detached Therm. | Dew Point. | State of the Weather. |
|---|---|---|---|---|---|
| H. M. | INCHES. | | | | |
| 11 30 | 29.949 | 74°.3 | 69°.9 | 57°.0 | |
| 45 | 29.945 | 74.8 | 69.8 | | |
| 12 15 | 29.941 | 74.7 | 70.8 | 58.0 | |
| 30 | 29.942 | 75.0 | 72.2 | | |
| 45 | 29.943 | 75.7 | 71.9 | | |
| 1 0 | 29.940 | 76.0 | 72.2 | 58.0 | |
| Means | 29.942 | 75.4 | 71.8 | 58.0 | |

### *Calculations of the Height of Ben-Lomond above the Sea, from the preceding Observations.*

Let B denote the height of the mercury in the barometer at the lower station, and $b$ that at the higher. Then, according to our formula, in which $\tau$ is the temperature of the attached thermometer, $t$ the temperature of the air, and $d$ that of the dew point at the lower station, and $f$ the corresponding elasticity of aqueous vapour, also $\tau'$, $t'$, $d'$, $f'$, the same at the higher, the following operation will give the height, from observations made at Ben-Lomond.

INCHES.

$B = 30.328$, $\tau = 75°.5$, $t = 75°.5$, $d = 60°.0$, $f = {\cdot}5354$

$I.\ E = -.033$

$B' = 30.295$

$b = 27.064$, Cor. $= +.034$, $\tau' = 60.1$, $\tau - \tau' = 15.4$, $t' = 60.2$, $t + t' = 135.7$, $d = 49.5$, $f' = {\cdot}3284$, $f + f' = 0.8638$

$E'' = 1.0153$

$b' = 27.098$

$B' + b' = 57.393$

$B' - b' = 3.197$ log. bar. co-efficient or C . . . . 4.780032

$t + t' = 135°.7$ log. E′ . . . . . . . . 0.027540

Lat. $= 56°$ log. . . . . . . . . . 9.999566

$B' - \frac{1}{10}f = 30.241$ log. 1.480596

$b' - \frac{1}{10}f' = 27.065$ log. 1.432408

Diff. 0.048188 log. . . . . . . 8.682946

$E'' = 1.0153$ log. . . . . . . . . 0.006594

$H' = 3138.2$ log. . . . . . . . . 3.496678

$h = 2.0$ = height of cistern of lower bar. above the lake,

$h' = 2.0$ = height of summit above the cistern of upper barometer.

$h'' = 32.0$ = height of surface of lake above the sea,

T. H = 3174.2 = height of Ben-Lomond above the mean rise of half tide at Dunbarton, by observations taken with barometers at the top and bottom.

We now proceed to calculate the height, by comparing observations made at the Caltonhill with those on the top of Ben-Lomond, distant about sixty miles from each other.

INCHES.

$B = 29.942$, $\tau = 75°.4$, $t = 71°.8$, $d = 58°.0$, $f = .4928$

$I.\ E = +.021$

$B' = 29.963$

$b = 27.064$, Cor. $= +.034$, $\tau' = 60.1$, $\tau - \tau' = 15.3$, $t' = 60.2$, $t + t' = 132.0$, $d' = 49.5$, $f' = .3284$, $f + f' = 0.8212$

$b' = 27.098$

$E'' = 1.0146$

$B' + b' = 57.061$

$B - b' = 2.865$ log C . . . . . . . . 4.779966

$t + t' = 132°.0$ log E′ . . . . . . . . 0.026124

Lat. $= 56°$ log . . . . . . . . 9.999566

$B' - \frac{1}{10}f = 29.914$ log. 1.475875

$b' - \frac{1}{10}f' = 27.065$ log. 1.432408

Diff. 0.043467 log. . . . . . . 8.638160

$E'' = 1.0146$ log. . . . . . . . 0.006295

$H' = 2819$ log = height of Ben-Lomond above the Caltonhill. 3.450111

$h = 355$ = height of Caltonhill bar. above the sea,

$h' = 2$ = height of summit above cistern of barometer.

T. H = 3176 = height of Ben-Lomond above the sea at Leith.

The mean of these two heights is 3175 feet, and they differ only by 2 feet from each other, or only 1 foot from the mean. This shows that, even at the distance of 60 miles, very considerable confidence may be placed in the determination of heights by the barometer, when the observations are carefully made with good instruments under favourable circumstances. It may be remarked, however, that the barometer at Edinburgh stood very steadily for some days previous and subsequent to the time at which our observations were made; and perhaps a like degree of consistency, at such a distance, could not be expected, if the barometer had been in a fluctuating state.

It was intended to have determined the height geometrically, at the same time, in order to judge of the degree of accuracy of our formula and tables; but the unsteady state of the weather, during the early part of the month of August, prevented the attempt. On this account we shall content ourselves, for the present, by comparing it with the height computed from data, communicated by Colonel Colby to Professor Leslie, and given in the copious and valuable notes appended to his Elements of Geometry, fourth edition, page 434.

| | | |
|---|---|---|
| Height geometrically by Professor Leslie, | - | 3177 feet |
| Mean of our two barometrically, | - | 3175 |
| Difference only, | - - | 2 feet. |

On account of this close coincidence, it is probable both are very near the truth.

As an appendix to this paper, may be added a determination of the quantity of water annually discharged by the river Leven from the basin of Loch-Lomond.

Having spent a day or two at Kirkland, near Bonhill, with a few acquaintances, I was induced, from the opportunities which I then enjoyed, to attempt this problem. In it I was cordially assisted by my friend Mr Robert Davie, who was residing there at the time, in taking the necessary measurements. By these I found the discharge to be about 59,969 cubic feet per minute. Now as 36 cubic feet of fresh water is very nearly equal to a ton, this gives 1665 tons per minute; and, supposing the year to consist of 365 days 5 hours 49 minutes, the annual discharge, at that rate, will be 877,925,085 tons. But as the river was rather below its average height, one-third may be added to this result; and we have about 1,200,000,000 or twelve hundred millions of tons per annum. As extreme accuracy in such computations, unless made daily throughout the year, is not to be expected, our conclusion can only be looked upon as a tolerably close approximation to the truth.

We have also made several barometric measurements of the height of Arthur's Seat in a variety of weather, as well as of some of the highest of the Pentlands, but the length to which this article has already extended prevents us from discussing them for the present.

EDINBURGH,
*Nov.* 1828.

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## *Miscellaneous Chemical Observations.* By JOHN DAVY, M. D. F. R. S. Physician to the Forces. Communicated by Sir JAMES MACGRIGOR, Director-General of the Army Medical Department [*].

### 1. *Effects of Light on Solution of Tartar Emetic and Antimonial Wine.*

WHEN a solution of tartarite of antimony and potash is exposed for some weeks to the direct rays of the sun, in a close vessel, it is rendered turbid, and a precipitate forms, which has the properties of the protoxide of antimony. In one instance, that a drachm of tartar emetic, dissolved in four ounces of distilled water, was exposed to sunshine at Corfu and Malta, during twelve months, the precipitate collected weighed one grain, and consisted of peroxide as well as protoxide of antimony. The decomposition, from the action of the sun's rays, takes place very slowly at first, till the solution has become turbid, and then the change is greatly accelerated. This probably is owing to the particles of oxide of antimony disengaged exerting an influence on the others similar to what is witnessed in the experiment of the precipitation from an acid solution of one metal by another.

It might, perhaps, be expected, that antimonial wine would be more liable to change, from exposure to the sun's rays, than a solution of tartar emetic: But it is the reverse. After a year's exposure, a portion of this wine, according to the London Pharmacopœia, had undergone no change; and two different samples of antimonial wine, one made with a sweet wine like Malaga, and another with a dry wine, like cherry, which had been kept many years in the Mediterranean, exposed to dull light, were both as good as when first prepared. There was a very minute sediment of extractive matter in the first, and a more considerable one in the second, which appeared to be composed chiefly of tartrate of lime and vegetable colouring, and extractive matter, without oxide of antimony.

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[*] I have prefixed titles to the different articles.—EDIT.

The application of these results to pharmaceutical purposes are so obvious, that it is useless to point them out.

### 2. *Effects of Light on Solution of Superacetate of Lead.*

Superacetate of lead, dissolved in water, is more readily decomposed than the preceding salt by the sun's rays. Carbonate of lead is precipitated. The minute changes attending this effect I have not investigated.

### 3. *On Nitrate of Silver as a Test for detecting the presence of minute quantities of Vegetable and Animal Matters in Water.*

Nitrate of silver, dissolved in pure water, is not altered by the sun's rays. If the minutest quantity of vegetable or animal matter is present, the solution is discoloured; and, with common distilled water, the discoloration is strong. To prove that the cause of the change of colour is the one assigned, it is sufficient to allow the coloured matter to subside, decant the colourless solution, and expose it again to sunshine. However powerful the sun's rays are, no farther effect is produced; but add more common distilled water, and the phenomenon will instantly reappear.

I believe, nitrate of silver, thus used, is one of the best tests of the presence in water of very minute portions of vegetable and animal matter; of course, any chloride of silver that may be formed, in consequence of the presence of any muriates, should be allowed to subside in the dark, and the subsidence should be complete before the fluid is decanted and exposed to light.

### 4. *On the Solubility of Phosphorus in Water.*

Phosphorus is commonly considered insoluble in water. From some observations which I have made, I infer that it is very slightly soluble.

Distilled water (a phialful, well corked and inverted), in which a piece of phosphorus had been immersed twenty-four hours, filtered, had a distinct odour of phosphorus, and was just perceptibly luminous in the dark.

The experiment repeated, using water impregnated with carbonic acid gas, with sulphurous acid gas, and with nitrous gas, indicated the same. In each instance, the water, after having been filtered, smelt of phosphorus, but was not distinctly luminous.

If there is no fallacy in the results, (and I am not aware of any), they seem to warrant the above conclusion.

### 5. *On the Temperature at which Phosphorus melts.*

According to Pelletier, phosphorus melts at 99°; according to Dr Thomson, at 108°. *

The phosphorus which I have tried, melted at 112°. At 110°, I have found it brittle, and very easily reducible to powder. Gradually, and very slowly cooled, in a solution of potash, I have seen melted phosphorus liquid at 72°; then, when touched with the thermometer, it suddenly became solid.

### 6. *Solution of Potash as a Eudiometrical Test.*

I believe that a strong solution of potash may be usefully employed in eudiometrical researches with phosphorus, to ascertain quickly, and with certainty, without calculation, the exact quantity of azote. This opinion is founded on the fact, that potash separates phosphorus from azote; and the results of the eudiometrical experiments in which I have tried it, are favourable to its correctness.

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* System of Chemistry, 5th edition, i. 261.

### 7. *On the Taste and Smell of Boracic Acid.*

Dr Thomson states, (on the authority of other chemists), that boracic acid has "a sourish taste at first, then makes a bitterish cooling impression, and at last leaves an agreeable sweetness *." The taste of this acid to me is bitterish, not unlike that of Epsom salts; and I have perceived no after sweet taste.

The same author states, that boracic acid "has no smell; but when sulphuric acid is poured on it, a transient odour of musk is produced." On repeating this experiment, I have never been able to detect this odour.

He states farther, that "it reddens vegetable blues." When I have tried it, it has reddened them very slightly; and has rendered turmeric brown like an alkali, which, if I recollect rightly, has been noticed by Mr Faraday; but I am not sure of it. [Mr Faraday has noticed that it renders turmeric paper brown like alkalies.—EDIT.]

### 8. *On Borat of Silver.*

Dr Thomson says, "borat of silver may be formed, by pouring a solution of borax into liquid nitrate of silver. The salt falls to the bottom in the form of an insoluble white powder, which has not been examined."

I find that boracic acid does not precipitate silver from the nitrate; and also, that, if the excess of base in borax is neutralised by boracic acid, or nitric acid, it does not precipitate nitrate of silver. It may be inferred, therefore, that the precipitate alluded to by Dr Thomson is either oxide of silver or a triple salt.

### 9. *On the Purgative Quality of Glauber Salt, as connected with the Sulphat of Iron it contains.*

Out of six different specimens of Glauber salt which I have examined, I have found five to contain a small quantity of iron, (probably the sulphat), and one only free from iron. The iron was detected by aqua ammonia added to the salt in solution; it occasioned a yellowish brown precipitate. Dr Paris, if I recollect rightly, in his Pharmacologia, expresses it as his opinion, that

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* Opus cit. ii. 91.

Glauber salts are a more tonic aperient than Epsom salts. The presence of a little iron in the one (and I have never been able to detect it in the other) aids in accounting for this difference in effect. No doubt, Epsom salts may be made tonic by the addition of a very minute portion of iron; and particularly of the sulphat.

### 10. *Oxygen disengaged during solution of pure Potash in Water.*

The pure potash of the shops (hydrate of potash), which I have made trial of, and the potassa fusa, during solution in water, give off gas, which I have found to be oxygen. The former, in the act of dissolving, effervesced strongly, and afforded a considerable quantity of oxygen: the latter a much smaller quantity. Of course, it must be inferred, that this disengagement of oxygen is owing to the presence of some peroxide of potash, gradually formed by the absorption of oxygen from the atmosphere. I have not found any oxygen gas disengaged by hydrate of soda, when dissolving in water.

### 11. *A new compound of Muriatic Gas and Muriatic Ether.*

When alcohol is agitated with chlorine gas, I have found that the temperature is suddenly very much raised; that the chlorine disappears; and that a fuming, pungent, etherial vapour is formed, which, from the few experiments I have made on it, appears to consist of muriatic acid gas and muriatic ether, as it is commonly called.

### 12. *There are more than two distinct combinations, of Ammonia and Carbonic Acid.*

Subcarbonate of ammonia, when exposed to the atmosphere, it is well known, emits a pungent ammoniacal odour. After a time, this odour ceases, and the residual salt is inodorous and neutral; but it is still volatile, and gradually disappears. I have confined a portion of subcarbonate of ammonia in a tall bottle, with a glass stopper. After several weeks, it had not apparently diminished in bulk. Crystals of two different kinds had formed on that side the bottle which was nearest the wall of the room,—needle crystals and octohedrons, with truncated summits. Do not these results seem to indicate that there are more than two distinct combinations of ammonia and carbonic acid?

### 13. *Test for distinguishing Adulterated from Pure Musk.*

The musk of commerce, which I have examined, when mixed with lime, has emitted a strong ammoniacal odour. To ascertain if this was owing to the formation of ammonia from the slow decomposition of the musk, or to adulteration with some ammoniacal salt, after washing the musk first with dilute muriatic acid, and afterwards with water, and after drying it perfectly, it has been divided into two portions, and put into phials well closed, to one of which a few drops of water have been added. After several months, the perfectly dry musk has been found unaltered, and, in consequence of its dryness, almost without smell; whilst that very slightly moistened was covered with a kind of mildew, and emitted a powerful smell of musk, but none of ammonia; nor could any be detected by triturating the musk with lime. Hence it may be inferred, that when musk, in admixture with quicklime, smells of ammonia, it is impure or adulterated; and, farther, that, to preserve it well, it should be made perfectly dry, but that when it is to be used as a perfume, it should be moistened.

### 14. *Formation of a New Species of Ether.*

Alcohol saturated with sulphurous acid gas, kept many months, and then agitated with barytes in powder, decanted and distilled, has afforded a fluid more oily to the feel than alcohol, and of a peculiar acrid and etherial smell, seeming to indicate the production of a new compound, perhaps a new species of ether.

MALTA,
*October* 15. 1828.

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## *A Memoir regarding the Natural History of the District of Alford in Aberdeenshire.* By ALEXANDER MURRAY, M. D. Communicated by the Author.

THE district to which the following observations relate, lies in a westerly direction from Aberdeen; the nearest part being more than twenty miles from that city, and not a less distance from every other maritime point. It consists of seven parishes, namely, Alford, Tough, Keig, Tullynesle, Forbes, Cushnie, and Lochell. These form a tract, in circumference perhaps thirty miles, divided by a hilly interrupted ridge, running from the upper part of the parish of Alford to the opposite extremity of Tough into a flat portion, about five miles long, and less in breadth, called the Valley of Alford, and a hilly portion of greater extent, which may be named the Hilly Part of Alford *.

The following paper, the result of observations begun some years since, during my residence at Alford as a practitioner of medicine, and, for the most part, committed to writing before I left that quarter, consists chiefly of an account of the native vegetable productions; and, upon this part, the merit of the memoir (if it possesses any) must in a good measure rest. On other branches I do not venture to aim at being complete; and not professing to give a full history of the district, I feel at liberty to select my own subjects, and pursue them only to the length I may deem proper. Regarding the face and nature of the country, some observations are to be made, which will, I trust, be found in themselves not entirely devoid of interest; and they will, probably, render the botanical remarks more acceptable.

### *Physiognomy of the Country.*

Alford, as it is remote from any great road leading to much frequented places, is less known to strangers than most parts of Britain. At an earlier period it seems to have possessed few attractions, and, indeed, to have been behind almost every spot in Scotland; but now, in regard both of fertility and scenery, it is above mediocrity. The valley, seen from its upper part, under favourable circumstances, presents a view not a little imposing, particularly to those who have seen it from certain other stations, where the prospect is, in comparison, tame and uninviting. To a spectator, placed, in a clear day of summer or early autumn, on the hill of Caillievar, the vale of Alford, made up of its fields and woods, with the winding Don, having the mansions of various proprietors on its banks, the scene terminating in the seat of Lord Forbes and the striking hill of Bennochie,—affords a prospect well deserving of notice. Finer plains may in no few places be met with, and grander views are easily found; but I venture to pronounce it difficult to find in Britain a view which communicates so much the idea of fertility, along with the same degree of the picturesque. I cannot quit the station mentioned without glancing at a few circumstances within the eye's compass, which naturally attract attention, though they do not lie in the tract which these observations for the most part regard. Placed, as already mentioned, we have, as it were under our feet, the remarkable ruins of Kildrummy Castle, standing at the extremity of a plain, that contains several of the excavations known by the name of Pictish-houses or *Yerd-houses;* and not very far off, the hill of Noth, worthy of notice for having on its top one of the most complete of the vitrified forts, structures so interesting from their antiquity, and the uncertainty that hangs over their origin, and from their being almost, if not entirely, confined to Scotland. At a greater distance, and in a different direction, we see the lofty mountains of Morven and Lochnagarr, from which Byron has said that he derived his earliest inspiration; and, lastly, it will be allowed me, in a memoir of the present kind, to point out the glimpse that we catch of a region which, as the scene of many of the labours of the botanist George Don, will ever be regarded with interest by the lovers of the branch of science that he cultivated with so much ardour and success. Since I have, almost without intention, entered upon scenery, it may be added, that the prospect from Bennochie, a hill situate between Alford and Garioch, is also of an uncommon character. On the one hand, we have a vast lowland tract, composed mainly of the districts of Buchan and Garioch; and, on the other, an extensive view of the high-lands of Aberdeenshire. I know not in what part of Scotland so large a plain is to be found; and, I presume, the countries are not many in which a view of so much level land could be got, and also of so much high-lands, from the same spot. The most singular part of the case is, that, of the wide circle within our view, one-half, as nearly as may be, is hilly, while the other half is the extensive plain which has been noticed.

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* When the whole district without distinction is alluded to, I have simply used the term *Alford*. This explanation is necessary, because that term is used in many different senses; as, besides the meaning just mentioned, it is sometimes applied to the parish and sometimes to the valley of Alford; and, in an account, published a few years ago, of the diseases of that quarter, I used it to denote a space larger than the valley, but less than the tract which in the present paper is termed Alford.

Alford forms a natural district, having, for the most part, a complete boundary, from hills of no inconsiderable size. Among these, I can only mention with exactness the altitude of Bennochie, stated by Dr Keith, in his Survey of Aberdeenshire, as being 1440 feet high; but I may observe, that the hills at the upper part of Cushnie are probably much above 2000 feet. Besides the valley of Alford, which is by far the largest flat part of the district, the interior consists of valleys, rising grounds and hills; and, seen from a point calculated to command a view of the whole, it presents a hilly and wooded appearance,—a Highland prospect on a small scale. From the valley of Alford to the upper part of Cushnie and Lochell, a gradual, but considerable, rising takes place, so that, while the lowest part of Keig is about 400 feet above the sea, the flat and cultivated tracts at the upper part of the district have, if I mistake not, an elevation of not much less than 1000 feet. Of the hills scattered over the surface, none is very conspicuous, if we except Caillievar, the elevation of which Dr Keith found to be 1480 feet.

The part of the country not under cultivation, may be divided into dry and chiefly hilly ground, and ground which is low lying and wet. The high ground is chiefly covered with heaths, plants bearing various kinds of berries, rein-deer moss, and different species of club-moss; while its surface usually consists of a thin peaty soil, and sometimes an impure clay. On the low and wet grounds, the native products are chiefly different sorts of grasses, carices and rushes; and here we usually find an intermixture of peat or loam (both being the product of vegetables that have decayed under different circumstances, it is difficult to tell where the one ends and the other begins), with a gravelly or clayey subsoil. At a former period, probably all the land in the district belonged to one or other of the above kinds; but now a considerable part has been long under cultivation, and the soil to some depth converted into vegetable mould, the appearance and nature of which varies according to several circumstances. I have omitted the peat mosses, but they are not extensive, a few being found on the hills, and others on the wet and level plains. Traces of ancient forests, usually of fir, though oaks have sometimes been found, are met with in various places; and perhaps originally a great proportion of the lower ground was covered with natural wood. At present, most of the uncultivated moors, as well as the eminences, when not of great height, are covered with wood, planted for the most part within the last fifty years; older trees, chiefly hard wood, are to be seen near the mansions of landed proprietors. In this district, no lake worthy of the least notice is to be found; nor is there any stream deserving to be mentioned, besides the river Don, which flows through the valley. Emerging from a tract, where, during a long space it had been almost encroached upon by the hills, it opens into Alford, and, after pursuing a winding course for several miles, it leaves that valley, and is again pressed close upon by the hills, as before.

The appearance of former cultivation, as indicated by the crooked ridges on rising grounds, not now subjected to the plough, may next be pointed out. On this subject various opinions are entertained; but there appears no good reason for doubting that those high places were cultivated only when the lower lands were, from wetness and the cover of wood, in an unfit state; and that, when a change was effected in the lower fields, the others were thrown back to nature. Some remarks on the reasons which exist for supposing that the valley of Alford was, at an early period, a lake, and on a peculiar sand, with a metallic lustre, that is found in the river, would not here be out of place; but not being prepared to enter on these subjects, I pass on to an account of the rocks, though, with regard to them also, I have to regret being unable to communicate a description so minute and complete as might be desired.

### *Geognosy of the Country.*

Alford is, for the most part, composed of granite, of which the constituent parts exist in every proportion, and in every form; and, in fact, it would be difficult to conceive quartz, felspar, and mica, combining together in a more varied manner than is there to be met with. Every description of this rock is to be found, from the granite, with its ingredients joined together in large irregular concretions, to the small granular compact rock. The quartz, in particular, has great variety of proportion and appearance. Besides the form which it takes in the more common granites, it is met with, at one time, in so large quantity, as to approach or pass into the common quartz-rock; and, at another, it appears in grains dispersed through the felspar, so as to form the appearance of porphyry, rather than of granite. Sometimes, again, it runs through the rock as a large vein; and, not very unfrequently, it is seen in fine parallel layers. I remember it on one occasion, so minutely dispersed through the stone, as to bear no faint similarity to the beautiful ramifications of calcareous spar often seen in newer rocks. In the rocks of the tract described, mica also has much difference of character, being, at one time, in scales of a large size, which, I think, happens mostly when the felspar is in very small quantity; and, at another, in scales of the smallest kind. It is particularly towards the north side of Alford that the mica abounds; the rock in that quarter passing from granite into true mica slate, of which a quarry is worked in the parish of Tullynesle. The felspar likewise varies much in colour and quantity. In the form of small loose stones it is often found pretty pure; and in the parish of Forbes, beds of that kind are to be met with; in which neighbourhood, I understand that, a few years since, search for felspar of a particular description was made, but without any satisfactory result, by persons connected with the manufacture of stone-ware in Staffordshire. In the neighbouring parish of Monymusk, a quarry of this sort was for several years worked, and the felspar transmitted to England; but as this has been given up, it may be presumed that the experiment has not answered expectation.

In point of hardness, the granite at Alford differs greatly at different places; but, in general, it is to be considered of a kind tending to separate and crumble down; from which cause the hills usually have a rounded aspect, and are without the bold abrupt summits to be seen in other parts of Aberdeenshire; and, indeed, usually forming a characteristic feature of granite districts. From this remark we must except Bennochie. Around, and near the highest part of this mountain, are strewed blocks of granite of every size and shape, placed in almost every possible position; some rather soft, but many so hard, that on these the humblest lichen has never been able to fix its habitation; but, in comparison with other hills in the neighbourhood, the chief peculiarity of Bennochie is its bold peaks, that communicate to it, when viewed from certain points at a distance, a remarkably grand and striking aspect. For building, the best varieties of granite in Alford are two; a stone characterised by a blackish colour, derived from hornblende, being mixed with the other ingredients; and another of a reddish colour, from the abundance of a flesh-coloured felspar. These are the stones most esteemed; but the forms of granite, as already stated, are without number.

In connection with the present subject, a rocky ridge, conspicuous at a great distance, situate on the south side of the Alford district, deserves to be mentioned. It is from forty to fifty feet broad, and extends from north-east to south-west for several miles; but I only examined it near the division between the parishes of Tough and Lumphanan, where the outside is a beautiful porphyritic felspar, similar to a few blocks found on Bennochie, and the inner part is of the ordinary reddish granite.

In Alford, limestone makes its appearance only in small quantity, and at a few places, namely, at one spot in Tullynesle, at another in Tough, and at a third in Cushnie.

As to the loose stones, scattered over the face of the country, I may observe, that though for the most part granite, variously altered by the weather, the proportion of pretty pure felspar and of quartz is among them greater than in the rocks of the district. It may be added, though not having myself attended to the point, I cannot give an opinion regarding it, that Mr Farquharson, minister of Alford, has assured me that the loose stones are almost invariably portions of rock lying to the north-west; and that, consequently, from the quarter just alluded to, a flood, or some other mighty agent, had, at one time, passed over Alford, carrying these stones from their native beds to the spots which they at present occupy.

Though it is no part of the present plan to dwell upon the neighbouring districts, it may be observed, that in them I have met with nothing relating to the rocks, worthy of record, unless, perhaps, what follows. Upon advancing higher in Aberdeenshire, into the parishes of Strathdon and Glenbucket, hornblende is met with more frequently than in Alford. In that quarter the hornblende and quartz are mixed in large irregular masses, while sometimes an immediately contiguous part of the same piece exhibits the exact appearance of the stone composing the statues deposited by Belzoni in the British Museum, which are reckoned characteristic specimens of the Egyptian syenite. Limestone is found in many places of the parishes just mentioned, and is sometimes so hard as to be susceptible of a polish, and receive the name of marble; but I have seen none whose colour is so good as to render it of value as an ornamental stone. In Towie, also, this rock is much more common than in the Alford districts.

The quarry of Kildrummy, known there by the name of *freestone*, so different from the other rocks in the neighbourhood, should not pass without some notice. This is a sandstone appearing to consist of argillaceous earth, coloured in various places with iron, and studded with grains of quartz and mica; and in various parts of which small rounded and angular portions of quartz and of gneiss may be observed. The particular formation to which this sandstone belongs I had no opportunity of determining *.

The rock of a remarkable hill that I met with in Strathdon, which is known by the name of *the Green Hill*, and runs across a small valley or glen in that parish, is next to be mentioned. This is a bed of serpentine of a dull dark-green colour, appearing, in various places, in the form of a bare rock, with much of the star-like aspect, that gives the name of trap to rock of a different description. The same mineral is found, as I know from a specimen in my possession, at no great distance from the spot first mentioned, namely, at a hill called Towanreef. I have also seen it more recently in several parts of the parish of Leslie; and have reason to believe that it extends still farther towards the sea, at least that it is to be found in the parish of Premnay. These masses of serpentine are much the same as the stone in Banffshire, which, from being at one time exported in considerable quantity, is well known by the name of Portsoy marble; but the Aberdeenshire serpentine wants the hardness and colour which constitute the value of that from Portsoy. The case, indeed, is different with respect to part of the rock in the parish of Leslie, where I observed a mass of this mineral in which the lustre was considerable, and the dark green colour gave way, for the most part, to a bright yellowish hue; but as the grains of the stone were not fine enough for a good polish, and the fissures in the rock appeared numerous, I am not sure that it could be turned to use in ornamental architecture. This Aberdeenshire serpentine contains asbestus, a substance which, at a former period, was found in such quantity at one of the stations pointed out, viz. Towanreef, that I understand various articles were constructed from it, and I have heard that the father of the present proprietor of Craig, on whose estate the hill, I believe, is situate, had, in his possession, a hat-band made from the asbestus of Towanreef.

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* It is one of the sandstones interposed between the coal formation and the lias limestone.

The serpentine tract, of which I have given an imperfect account, contains a substance yet more interesting than asbestus, which may prove of importance to the proprietors of the ground,—I mean chromate of iron. Professor Jameson, from the inspection of a small specimen from the *Green Hill* in Strathdon, expressed an opinion that it contained imbedded grains of the substance just mentioned; and he added a wish that the district were more particularly examined, with the view of discovering whether the chromate existed in such quantity as to be of practical consequence. Since receiving this communication from the Professor, I have not had an opportunity of making any farther investigation, nor am I a judge of what quantity of the chromate would render its extraction a profitable object. This substance is now well known as assisting to form various articles used in painting, dyeing, and calico-printing; and its value is so great, that, as I know from good authority, the proprietor of a serpentine tract in Shetland, where chromate of iron was found by Professor Jameson, cleared, in a few years, L. 8000.

### *On the Connection of Plants with the Soil on which they grow.*

After these remarks on the face of the country and the rocks, I wish to observe, that not unfrequently I have endeavoured to discover whether, in the comparatively limited tract to which the present observations relate, any decided connection could be traced between the native plants and the soils wherein they are found. Few inquiries are more inviting; and the opinion that a connection of this kind exists, has at least a plausible appearance; but, after some attentive consideration, I venture to suggest, that there is not in science a more hopeless labour than the attempt to discover an unvarying and necessary relation between most plants and the chemical nature of the soils in which they spontaneously grow. I feel convinced, that, except in point of moistness, compactness, and depths, soils have, in general, no cognizable relation to their native products. This opinion is, on my part, the result of observation; and it appears, when well examined, no less to accord with reason than experience. Let us survey Britain, for example, and we find the soil, in all places, composed mainly of silica, alumina, magnesia, and lime, with accidental animal and vegetable impregnations. Now, is it reasonable to expect, that we could, in our present state of knowledge, trace a general relation between those few elements of soil, and the highly diversified vegetable products which are indigenous in our island? Or that we shall ever extend our knowledge of the intimate nature of soils, or of vegetable functions, so far, so very far, beyond its present limits, as to enable us to solve the problem in question?

It has been already hinted, that certain vegetables require a certain depth of soil; and, upon this principle, the degree of tendency to disintegration possessed by the rocks is connected with the vegetable products. Thus, on the north side of the Alford district, where the rocks have a peculiarly micaceous character, and readily crumble down, the mineral soil, and, consequently, the vegetable, is deeper than on the other hills; and there the heather is most mixed with grass, and the native berries most abundant and perfect. It will be readily admitted that exceptions exist to the opinion that soils are not indicated by their natural products, and perhaps none is more remarkable than may be adduced from the Green Hill of Strathdon. This has been already noticed on account of its peculiar rock; and, it is remarkable, that its vegetation is also peculiar, entirely different from that of the contiguous hills. These are invariably clothed with the heaths; but the hill just mentioned derives its name from a green covering of grass. It produces, as is also worthy of notice, Arenaria verna, Cochlearia officinalis, and Statice armeria, of which the two last are extremely rare in that quarter; and as to Arenaria verna, I never met with it in that part of Scotland, unless in the spot mentioned, and again at Leslie, growing on the very serpentine rock with which it is associated at Strathdon. I have thus admitted some striking exceptions to what I have ventured to bring forward as the general result of observation; but it may be asked, Whether the exceptions are more numerous than those which present themselves against every general rule? If it were stated that the conclusion here supported must be inaccurate, because the vegetation of the hill is always different from that of the moor or the bog, I should answer, that this depends not strictly upon the ingredients of the soil, but rather upon other circumstances, namely, its wetness and depth. Let a wet spot on a hill be examined, and there will be found not the heaths, &c. which cover the thin dry soil in the neighbourhood, but the same grass, the same rush, the same willow-herb, &c. as in the plain below. The wetness favouring luxuriance, produces an increase of that soil which is formed by the decay of vegetables; and plants, which could not find a place in the adjacent thin and dry stratum of peat, fix themselves and thrive in this moister and deeper soil, though it be not chemically different from that which surrounds it. No doubt, if we go to a certain height, the vegetation undergoes an alteration; but this may depend upon the cold and dryness, rather than on any change in the chemical ingredients. But, after all, how few are the truly alpine plants of Europe, in comparison with those which are occasionally found at almost every altitude?

### *Effects of Hoar-Frost on Plants.*

The thermometer at Alford has a greater range than at the seaside, the temperature being higher during the hottest months, and lower during winter, than in the neighbourhood of the sea. I, however, made at Alford no observations on the thermometer extensive enough for being mentioned; but I may notice, that, in a late number of the Edinburgh Journal of Science, it is stated, on the authority of Mr Fairholme, that, one morning in winter 1825–6, the thermometer, in the parish of Keig, stood at 5° below zero. I am also unable to furnish any experimental observations on the moisture of the atmosphere; but, considering that the district is environed by hills, and that much of the rain which falls will naturally find its way to the plains, we may believe the air to be rather of a humid description.

These observations on temperature and moisture, lead me to remark an evil connected with these circumstances, which takes place in the valley of Alford, to an extent not frequently paralleled in other places; I mean the injury which the crops sustain from hoar-frost, in the end of summer, or the early part of autumn. This takes place, for the most part, in low situations; and as these lie, in general, near the river and marshy ground, and are themselves often wet, the injury is usually ascribed to a cold vapour rising up from the river and wet places. As far as the river is concerned, the opinion is undoubtedly without foundation; for fields in the neighbourhood of many other rivers suffer no damage of this kind: and, farther, the injury only takes place when there is no wind which could waft the vapour from the river to the adjoining grounds. It is, besides, well known that vapour never rises to a great extent, except when a current of air is passing over the evaporating surface; but, during wind, as I have mentioned, the frosting of crops never takes place. A crop, indeed, upon a wet soil, may be apt to suffer from hoar-frost, in so far as the atmosphere over it is, during a calm, perhaps more loaded with vapour than in other situations; and, consequently, more calculated for depositing dew and hoar-frost. A crop also, near a wet grassy situation, may be injured in this way. Surfaces of that kind are well known to throw off, in clear nights, their heat very readily; and the coldness thus produced will be communicated to fields in the neighbourhood. I doubt, however, whether the state of the ground as to moisture has any material influence over the hoar-frost, and am rather disposed to explain all the circumstances upon the principles laid down by Dr Wells and others, as regulating the formation of dew and hoar-frost. In a cloudless and perfectly calm night, the earth throws off the heat it had received during the day, in such a manner, that its surface, as well as the air, for several feet upwards, becomes often 10° or 12°, and sometimes 15° colder than the rest of the atmosphere; and the formation of dew or hoar-frost naturally takes place. Farther, it is known that a flat or horizontal surface loses more heat, and therefore becomes more loaded with dew or hoar-frost, than a similar surface, placed vertically, or with an inclination. In short, it is established, that a clear sky, a dead calm, and a horizontal surface, are the circumstances most favourable,—the two first being perhaps absolutely necessary,—to the formation of dew or hoar-frost; and these facts go far, I think, to explain the damage sustained by crops in the valley of Alford from hoar-frost. They shew why, in that situation, the lowest land, always more or less sheltered from the wind, and having frequently a horizontal aspect, is damaged; while the higher ground, exposed often to a current of air, when not a breath is stirring in the lowest situations, and which, besides, have usually an inclined surface, receive no injury. They shew also why the valley of Alford, surrounded by hills, and in that way sheltered, suffers more than other valleys and plains. In larger valleys, the hills must have less influence in restraining the currents of the atmosphere; and, in very small valleys, the air is seldom at rest, for reasons which it is unnecessary to discuss. The same circumstances also explain why, in accounting for the frosting of crops, more stress than appears due has been laid upon the wetness of the ground. In a tract surrounded by hills, the lowest situations are, for obvious reasons, apt to be peculiarly wet; and, as the injury from hoar-frost takes place mostly in low situations, it is naturally, at first sight, attributed to the wetness. But it is to be remembered, that the low situations are likewise the flattest and the calmest; and, upon these circumstances, much more than on the wetness, does the injury in question seem to depend.

Against the frosting of crops, shelter has been recommended; but unless it is of a kind calculated to keep off the rays from the morning sun, shelter, in place of being useful, will probably aggravate the injury. Not so, however, with respect to frost affecting the crops in late seasons. Of such crops, shelter is the main safeguard, as then the whole atmosphere, and not merely the stratum next the earth, is occasionally below a freezing temperature; and wind, instead of bringing up successive portions of warmer air (by which means it prevents hoar-frost), can have no effect but that of rendering the cold more energetic. So, in late seasons, high grounds, from being most exposed to cold and wind, suffer more than low and sheltered situations.

### *Waters of the District.*

From a series of experiments I made in the wells and springs of Alford, the following inferences may be drawn:—No water was found wherein any uncombined substance of an acid or alkaline nature was detected. Sulphuric acid was but seldom met with; lime was occasionally present, but more frequently no trace of it was perceived. Almost universally muriatic acid was indicated. The usual tests of magnesia and potash shewed no sign of these substances. For no other substance was inquiry made; but as there was frequently found no base which could have neutralized the detected acid, it may be considered probable that soda (of which no direct test is known) was often present. I have still to say, that a little iron was found in several springs. On the whole, the water of Alford may be reckoned freer from foreign ingredient than is common; and, in comparison with most waters, the quantity of sulphuric acid and of lime is peculiarly small.

### *Observations on the Importance of Natural History.*

An account of the native vegetables of Alford is now to be given, and this is offered under the hope, that the botanical description of a portion of country, whose plants are fully known to no individual except myself, will be considered of a more acceptable character, than if it had related to a situation near the more ordinary scenes of botanical research. Not a few persons ask the value of a catalogue of natural objects, which, in place of containing what they deem useful, is made up of names and stations; but local Floras are a class of productions ever interesting to the true lover of botany. It is only by a series of such performances, that the manner in which vegetables have been associated by the hand of Nature, can be fully known; or exact ideas formed as to the face of a whole kingdom. The class of persons above alluded to, not unfrequently demand the value of botany in a general point of view, which they say is a mere science of names, not leading to practical usefulness. I am far from wishing to be understood, as not holding in due esteem every description of attainments necessary or useful in the ordinary affairs of life; but I trust the time has gone past, for knowledge being valued only in as far as it tends directly or indirectly to promote bodily comfort and enjoyment, or to ward off physical ills. The true lover of knowledge, I conceive, is he who, not very fastidious about the peculiar advantages to be derived from this or that acquirement, follows knowledge for what may be called its own sake, that is, for the pleasure of acquiring it, and the satisfaction derived from its possession; while the man who takes no interest in any branch, unless he first clearly perceives a way of turning the pursuit to his own personal advantage or the public good, will seldom possess any enviable quantity of attainments.

Where would have been the immortal name and labours of Linnæus, had he shorn his writings of all the portions which are not of evident use, according to a certain sense of that term? It is, however, quite unnecessary for me to offer an apology for botany; but I may simply say, that, though it were of no practical utility, though no plant on the face of the earth possessed a single useful quality, this science, for the addition which it makes to the sources of human happiness, for the rational curiosity that it excites and gratifies, would be well worthy of being studied. I may, however ask, Whether there are no plants made use of in gardening, medicine, or agriculture? And if these are numerous, whether, without knowing the species, in other words, without being botanists, we could in general avail ourselves of their qualities? As to botany being a mere science of names, this is usually an assertion of those who are so little acquainted with the subject as not to know the names of twenty plants; and it is so completely devoid of foundation, in fact, no more applicable to the science alluded to than to any other branch of natural history, or to astronomy, geography, &c. that it scarcely merits more than a simple denial. Botany would have been the same substantial study as it is, though names had never been heard of. But though names are, from their obvious utility, numerous in all branches of natural history, it is to the novice alone that they put on a perplexing air; for he who completely understands things, will usually find, that, during his study of the more essential parts of the subject, the *names* have become imprinted on his mind without any effort.

Before quitting this digression, I may notice another class of critics who find no fault with botany, but only with the manner in which it is studied, and who, were they botanists, would, as they say, devote themselves to the virtues of plants and vegetable physiology, rather than to the aspect and relation of species. Now, the mineralogist, though often occupying himself with the physical characters of minerals, does not undervalue sound geological speculation; nor is he ignorant of the extensive application of his interesting branch of knowledge to the practical arts and sciences; so the botanist, when he puts forth a work relating only to the external appearance of plants, with their names, and places of growth, is not to be held as ignorant of their virtues and functions, or as despising that knowledge. On the contrary, he reckons the physiology of vegetables, and their uses, among the legitimate branches of his science. But he is disposed to consider these branches in some degree subordinate, being convinced that the descriptive part of botany, and of all natural history, ought ever to receive the most attention, as in a manner the foundation of the other branches, and being itself founded in truth and nature; while, unfortunately, what relates to the virtues and physiology of vegetables (however rationally interesting all that is *established* in these departments will always be), derives, in many instances, no higher regard than what is due to a plausible and ingenious fable. If, however, the descriptive parts of natural history, though advancing in esteem, have not yet, in Britain, quite reached their proper sphere, this cannot be said of several other parts of Europe, where mineralogy, zoology, botany, &c. are almost universally studied; and where I believe a knowledge of natural history, like the dead languages with us, is reckoned the criterion of a liberal education. By no means undervaluing the dead languages, either as a means of training the youthful mind, or in respect of the treasures which, in some instances, they open up, I may be allowed to doubt whether natural history does not supply knowledge of a kind equally substantial and useful, while it is an exercise not less calculated to improve and strengthen the mind. To the medical inquirer, there cannot be a doubt that the study in question, as it requires and encourages the same mental habits as are necessary in the discrimination of diseases, is of the greatest importance. Probably it is the study of natural history, so common on the Continent, which has enabled foreign physicians to carry to so great perfection their observations on morbid appearances, and the diagnoses of diseases. It may indeed be suspected, that, viewing disease as a mere piece of natural history, they have paid too great attention to morbid phenomena, and too little to the manner in which these might be prevented and removed; and, in this country, we indulge a belief, probably well-grounded, that however acute foreign physicians are in the discrimination of diseases, their medical treatment is less energetic and successful.

Waiving farther general remarks, I may observe, that the value of a local Flora will be regulated greatly by the degree of its accuracy and completeness. From the prevalence of a hasty and careless style of observation, we frequently have the merest guess-work recorded among the established facts of science; and loose and inaccurate speculations lead others into error, procuring at the same time for their authors a share of that credit which is due only to the faithful and patient observer. In point of accuracy, I trust the following account of the Alford vegetation will not be found defective; as, during no less than eight years, I had an opportunity of observing and examining the plants of that district. All were rigidly compared with the descriptions of Smith and Hooker; and, in every doubtful case, the figures of the English Botany, and sometimes living botanists of eminence, have been consulted. As to completeness, it may be mentioned, that, with exception of the part containing cryptogamic species, little farther on that head is, I trust, to be desired; for, in the course of an occupation, leading me times without number to all points of the district, I have examined every spot,—I have scrutinized every hill, plain, marsh and stream; and, without undue confidence, it may be said, that few or none of the native plants can have escaped me.

> "Atqui nec herba, nec latens in asperis
> Radix fefellit me locis."

I have been at some loss as to how specific I ought to be regarding places in which particular plants are found, as it may be deemed useless to mention many stations, all of them unknown to most of those into whose hands this paper may fall. At the same time, supposing it possible that the memoir may be thought of some service to vegetable geography, it is necessary that those who peruse it receive some information of the frequency with which the plants to be named are found. After consideration, I have inserted the stations only of those plants which Smith or Hooker consider so rare as to have given their habitats, and of such as are rare in Alford. Where no observation is made, it is to be considered that there is nothing remarkable in the degree of frequency with which the plant is met with.

## MONANDRIA MONOGYNIA.

*Hippuris vulgaris*, mare's tail; *Chara vulgaris*, common chara. Of these neither is common. The first is found in the moss at Balphlig, parish of Alford; the chara near Tullyfour, in Tough, and in Lochell.

## DIANDRIA MONOGYNIA.

*Veronica serpyllifolia*, thyme-leaved speedwell; *V. scutellata*, marsh speedwell; *V. officinalis*, common speedwell; *V. Beccabunga*, brooklime; *V. Chamædrys*, germander speedwell; *V. agrestis*, procumbent speedwell. Of these, *V. scutellata* is found occasionally in ditches at road-sides. All the others are common. *Pinguicula vulgaris*, butter-wort; *Utricularia vulgaris*, greater hooded milfoil, in the moss at Balphlig, but not common, and never, I think, bearing flowers. *Lemna minor*, lesser duck-weed.

## DIANDRIA DIGYNIA.

*Anthoxanthum odoratum*, sweet-scented spring-grass.

## TRIANDRIA MONOGYNIA.

*Valeriana officinalis*, great wild valerian.

* *Fedia olitoria*, lamb's lettuce; *Iris Pseudacorus*, yellow water iris; in the upper part of the parish of Alford, but perhaps the rarest plant in the district. *Scirpus cæspitosus*, scaly-stalked club-rush; not very abundant. *S. palustris*, marsh club-rush. *S. setaceus*, setaceous club-rush; rather sparingly distributed. *Eriophorum vaginatum*, hare's-tail cotton-grass. Near the foot of Bennochie, and no where else in Alford. *E. angustifolium*, common cotton-grass. *Nardus stricta*, mat-grass.

## TRIANDRIA DIGYNIA.

*Alopecurus pratensis*, meadow fox-tail grass; *Phalaris arundinacea*, reed canary-grass; *Phleum pratense*, common cat's-tail grass; *Agrostis canina*, brown bent-grass; *A. vulgaris*, fine bent-grass; *A. vulgaris* β (with short awns);

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* When there is the least reason for supposing that the plant is not truly native, but originally perhaps an outcast from a garden, I have, as in the case above, prefixed an asterisk.

*A. vulgaris* γ (*Agrostis pumila* of Lightfoot.); in the parish of Tullynesle. *A. alba*, marsh bent-grass; banks of several streams in Alford. *Holcus avenaceus*, oat-like soft-grass. *H. mollis*, creeping soft-grass. Lightfoot considered this rather a rare Scottish plant, but it is common at Alford, particularly, I think, on the estate of Breda, so as to be reckoned a troublesome weed. *H. lanatus*, meadow soft-grass. *Aira cristata*, crested hair-grass, common in the parish of Alford. *A. aquatica*, water hair-grass; in various wet places. *A. cæspitosa*, turfy hair-grass. *A. flexuosa*, waved hair-grass. *A. caryophyllea*, silver hair-grass. *A. præcox*, early hair-grass. *Melica cærulea*, purple melic-grass; on a few moors in very small quantity. * *Poa aquatica*, reed meadow-grass; in Breda's pond. *P. trivialis*, roughish meadow-grass. *P. pratensis*, smooth-stalked meadow-grass. *P. annua*, annual meadow-grass. *P. nemoralis* (?) wood meadow-grass. *P. decumbens*, decumbent meadow-grass. *Briza media*, quaking-grass; found on an islet in Don, opposite to Smithey Hill, the only station where this singularly beautiful grass is found. *Dactylis glomerata*, not common; in some of the church-yards in small quantity. *Cynosurus cristatus*, crested dog's-tail-grass. *Festuca ovina*, sheep's fescue grass; of this there are at Alford several varieties, differing mainly in the degree in which the florets are awned or pointed, and in the colour and size of the plants. *F. duriuscula*, hard fescue-grass. *F. bromoides*, barren fescue-grass. *F. myurus*, wall fescue-grass. *F. gigantea*, tall fescue-grass; found only, I think, on Don side, near Haughton. * *Bromus mollis*, soft brome grass. *Avena fatua* (?) wild-oat. *Triticum repens*, couch-grass. *Lolium perenne*, rye-grass.

### TRIANDRIA TRIGYNIA.

*Montia fontana*, water-Blinks.

### TETRANDRIA MONOGYNIA.

*Scabiosa succisa*, devil's-bit scabious. *Asperula odorata*, sweet woodruff; banks of the burn of Linturk, the only station. *Galium verum*, yellow bed-straw. *G. palustre*, white-water bed-straw. *G. Aparine*, goose-grass or cleavers; not very common. *Plantago major*, greater plantain. *P. lanceolata*, ribwort plantain. *P. maritima*, sea-side plantain; this I never saw at Alford but once, viz. in 1822, when I found a few plants near the toll-bar at Alford. *Alchemilla vulgaris*, common lady's-mantle.

### TETRANDRIA DIGYNIA.

*Potamogeton natans*, broad-leaved pond-weed. *P. fluitans*, long-leaved pond-weed. *P. lucens*, shining pond-weed. *P. pusillum*, small pond-weed.

I know not how others view the Potamogetons; to me they have always appeared one of our most perplexing genera; and the doubts have not been removed after examining the plants again and again, in connection with approved figures and descriptions. As to the plants which I have above named *P. lucens* and *P. fluitans*, I have sometimes supposed them neither of those two plants; and at other times they have appeared but one species, but at last I believe the above names to be correct. On looking just now into the English Flora, I find that I have been puzzled in good company, as Sir James Smith states Haller to have had much difficulty in distinguishing the two species above alluded to.

### PENTANDRIA MONOGYNIA.

*Myosotis sylvatica*, wood scorpion-grass. *M. arvensis* field scorpion grass. *M. versicolor*, yellow and blue scorpion-grass. *M. palustris*, forget-me-not. I have to add a Myosotis, which appears different from any of the species noticed by Smith or Hooker; and, therefore, I insert the following description:—Root fibrous; stem erect, strong, closely set with long spreading hairs, which are much stronger and more numerous than in the *M. arvensis*; leaves as usual in the genus; on the peduncles, pedicels, and calyx, as well as on the leaves, the hairs are pressed quite close; flowers large, many of them pale blue, some pale flesh-coloured, and not a few white; calyx gaping, but less so than in *M. palustris*, and having five segments, similar to those of *M. arvensis*; seeds as is common in the genus; peduncles, in the last stage, very long, weak, and horizontal, having occasionally a few leaves mixed with the lowest flowers; pedicels very long, sometimes an inch and a half, at first directed upwards, but latterly, perpendicular to the peduncle or common flower-stalk, or even with an inclination downwards; all the pedicels are at last directed to one side, whence the raceme has a marked unilateral appearance. This plant grows in wet places, like *M. palustris*, but I think it is more peculiar to springy and boggy places than *M. palustris*.

I am strongly of opinion that this is a new Myosotis, but it is so common, at least in the district of Alford, that it cannot be supposed previously unnoticed; but it may have been taken for a variety of *M. palustris*. This plant has characters fully as marked as any other species in the genus; and, indeed, its aspect is so different from that of any of the others with which I am acquainted, that I can invariably detect it, even when at too great distance for perceiving the tuft of the flowers, or the hairiness of the stem. *M. palustris* is decidedly distinguished from this plant, by having skye-blue and, I think, smaller flowers, a more expanded calyx when in fruit, with shorter triangular teeth, smooth, and usually red stems and leafless racemes. With *M. repens* of Don I am acquainted only through the Scottish Flora, and the few points there noticed certainly have a resemblance to the characters of the present plant. Hooker, however, makes *that* a variety of *M. palustris*. *This* I consider entitled to rank as a species. The description of the *M. cæspitosa* in the English Flora, corresponds in many respects with the plant alluded to; but that is described as having flowers smaller than *M. palustris*, while those of the plant described have always struck me as larger.

The whole of the above was written at Alford several years ago; and though it may be supposed that enough has already been said, I wish to add, that, upon shewing the plant to Professor Graham of Edinburgh, he expressed himself as being of my opinion; and, in fact, if I mistake not, he had, from his own observations, previously come to the same conclusion. I have also been favoured, within these few days, with a letter from Dr Hooker of Glasgow, and I will take the liberty of quoting the part of it that relates to the present subject:—

"Since the publication of my Flora Scotica, the attention of botanists has been much more directed to the species of that genus, especially in Germany; and many have been now ranked as distinct species, which before were considered as mere varieties, or were passed by as too trifling variations to deserve notice. Some of these alterations are, however, undoubtedly founded on good characters; and, I think, such is the case with the Myosotis in question. That which is included in your packet is the *M. cæspitosa* of Schulz, in Sturm's Deutschland Flora, and of Smith in his English Flora, vol. i. p. 250. The same species is taken up by Schrader, in Reichenbach's Amœn. Dresd. vi. 16; by Link, in his Enumeratio; by Bluff and Zingerhuth, in their Comp. Floræ Germanicæ; and, lastly, by Sprengel, in his Systema Vegetabilium, vol. i. p. 557. With all these authorities you may safely make it a species; and you have assuredly described its true, important, and, I think, unvarying characters."

After the decision of this very high authority, who appears to have taken the trouble of fully considering the subject, it would not be becoming for me to express or feel any doubt about this being *M. cæspitosa*; but, admitting it to be so, the plant is so far interesting, that the species is comparatively a new one; as it is only a few years since it was introduced into the English Flora, and, up to the present time, it has not been ranked among the Scottish species of Myosotis. Even in Germany, it appears from Hooker, that the plant had not been noticed at the time of the Scottish Flora being published. Rather before that time, it had occurred to me as being undoubtedly a good species.

As this paper is already quite long enough for the Journal, to which it is to be sent, I must conclude, with the intention of continuing the subject upon a future occasion.

CASTLE STREET, ABERDEEN,
*5th November* 1828.

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## *The subjects of Prize Essays proposed by the Dutch Society of Science of Haarlem.*

*(The Answers to be given in before the* 1*st January* 1830.*)*

SEEING the chemical analysis of vegetables has made known a great number of vegetable substances, or immediate principles of plants, and which, to all appearance, will be more and more augmented; and, as chemists differ in their opinions with respect to the nature of these substances newly discovered, which some think to be only modifications of substances previously known; while others take them for so many different substances, the Society desires an exact exposition, founded on positive characters, as well as an account of the use which may be made of these new substances, or of the plants which contain them.

Is the *Tannin*, so called, which is obtained from different plants, a real principle peculiar to these plants, or has this name been given to different substances derived from plants, which have the common property of being *astringents*, and of tanning leather? By what means may these substances be extracted purest from different plants; and by what means may it be known that they are not mixed, and that they do not differ from each other? What is the surest and quickest manner of producing substances adapted for tanning, by treating coal, or indigo, or other vegetable substances, by acids; and in what does this artificial tannin differ from the natural? Are they not both similar substances? In case a more perfect knowledge should be attained of the different tanning substances, of what use might it be, as well for the different trades and manufactures, as for the use that might be made of it in medicine?

What are in general the advantages and illustrations which, since Haller's time, physiology, or the physical history of man, has derived from zoology or comparative anatomy? What are, in particular, the organs of the human body, that have been made better known since that period; and what are the functions on which zoology and comparative anatomy have thrown new light?

The experiments of Sir Humphrey Davy having proved the influence which the difference of soil, climate, and season, is capable of effecting upon the relative quantity of the immediate principles of the cereal seeds, particularly of wheat, so that, for example, winter wheat contains a greater quantity of starch or amylaceous fecula, while the gluten is found increased in the summer wheat; and while the same principle is still more abundant in the wheat of North America than in that grown in England; and seeing that it would be of importance to know to what degree the circumstances indicated may influence the nature of the wheat cultivated in the Low Countries, the society desires, That it be demonstrated what are the differences which the above mentioned circumstances are capable of producing in wheat cultivated in this country; what are, in virtue of these inquiries, the best kinds of wheat intended for different purposes; and what instructions may be deduced from them, with reference to the cultivation of these grains?

What are the vegetable colouring matters known as particular principles? What are their nature and properties? What is the best method of separating them? By what means are they most altered, heightened, deepened and rendered fainter? And what uses and advantages result from this knowledge to dyers and other tradesmen?

What is at present known of the natural history of fishes of passage? What are the fishes known as such? What are the commencement, the direction, and the end of their course? and what particular circumstances have been observed with respect to them?

It is desired to see collected all that is at present known on this subject, especially with respect to those fishes which are employed for food, or for any other useful purpose.

*As the different branches of natural history have become, of late years, too extensive to be fully taught in an academical course, it is asked, What selection is to be made in the teaching of natural history, with the view of treating of what may be useful, as well in common life, as in other respects?*

Some medical men have been long of opinion, that certain diseases of the skin are caused by very minute insects, invisible to the naked eye, under the epidermis; while others do not admit this opinion. The society, therefore, desires to know, on what grounds has the existence of these insects under the epidermis been admitted; or what observations have contributed to its assumption? And, in case the supposition may be founded, What may be deduced from it, for the purpose of improving the treatment of certain cutaneous diseases?

As the chemical examination of animal and vegetable substances can no longer be confined to the extraction of the immediate principles of these substances, as was the case not many years ago, since we can now examine, according to the mode of chemical analysis invented by Thenard, Gay Lussac and Berzelius, in what proportion the simple principles are found combined in these substances; there is desired a memoir, in which will be exposed, 1st, What method of analysing the above mentioned substances, in their first principles, is actually proved to be the best, by the reiterated experiments of several chemists? 2d, Of what organic substances do we already know, with certainty, from authentic experiments, the proportion of their first principles. 3d, What advantage is this new method of analysing the above mentioned substances capable of imparting to the advancement of science; or what may be expected from it in future?

M. Thenard having found the means of combining water with large quantities of oxygen, and the liquid which is obtained possessing very peculiar properties, which are still in a great measure inexplicable; there is desired a memoir, in which, after a reiterated and careful examination, the properties of this liquid may be accurately described, and that an explanation, proved by experiments, be given of them; and in which it be also examined to what useful purposes this fluid might probably be applied, whether in medicine or otherwise.

As several species of mollusca, especially those which are found in the sea, are frequently employed among different nations; and as, according to the accounts that we find of them, wholesome, and even delicious, food is prepared from them; while of the mollusca which inhabit the sea near our coasts, there are only used oysters, mussels and sea-slugs; it is asked, What other mollusca, which do not occur at a great distance from our coasts, may be reasonably esteemed as good for food; and in what manner may it be tried whether they might furnish as wholesome as agreeable a food?

A violent propulsion of the sap in poplars, combined with the expulsion of a considerable quantity of air, having been observed by Coulomb, in April 1796, when he had perforated to the centre trunks of poplars, from four to five decimetres thick, does not appear to have excited other philosophers to repeat the experiment; and as this phenomenon is, notwithstanding, very worthy of being attentively examined, and as a careful investigation might perhaps give rise to interesting discoveries, the society promises the gold medal to him who shall take advantage of a favourable opportunity of repeating this experiment in spring, on the trunks of various kinds of trees, and of carefully observing all that may present itself in this phenomenon.

There may be expected for an approved answer, besides the gold medal, a gratuity proportionate to the interest of the results elicited by a careful examination.

Considering that the chemical experiments in Holland, especially those of P. Driessen, have shewn that the properties of atmospheric air near the sea, are more or less modified or altered by the muriatic acid which it contains; and that, in particular, the solubility of lead in water is thereby augmented; that, however, these observations have not been confirmed in other places, and that it is still required to be known if that acid exists quite free in the air, or in chemical combination with other substances, the society desires—That this subject be treated anew, and that it be tried by exact experiments to demonstrate, if, in these countries, the atmospheric air contains muriatic acid, what are the circumstances which augment its quantity, in what state it occurs in it, and to what degree the quantities of the air may be altered by it?

As several substances, which were formerly known only in the state of gas, may, through pressure and intense cold, be reduced to the solid or liquid form, which has especially been proved by Faraday's experiments; and as it follows that the division of bodies, according to their form, into liquids and gases, has become uncertain and less admissible, the society asks, 1st, In how far may the classification of bodies, according to form, be yet admitted? 2d, What are the truly gaseous and vaporous bodies? What use might be made in the arts of these substances, which, when they are strongly compressed or cooled, are capable of exercising a great degree of power by elasticity or dilatation?

Although the following questions, proposed to be answered before 1st January 1829, be too late of insertion, the perusal of them may prove interesting:—

What is the present state of our knowledge respecting the motion of the juices of plants? What are the observations and experiments which throw some light on the cause of this motion, and on the vessels or organs by which it takes place? What may be considered as sufficiently proved, by well verified experiments, of all that natural philosophers have written on this subject? What is there that may be considered as not yet sufficiently proved or merely hypothetical? And what use may be derived from the knowledge acquired in respect to this subject for the culture of plants?

The theory by which it is supposed that all the chemical actions of bodies are the effect of electricity being more and more adopted, there is asked,—A critical examination of all that experiment has proved on this subject, in order that we may be able to conclude from it, whether electricity alone ought to be considered as the cause of all chemical action, or if it be still necessary to suppose a particular power known under the name of chemical affinity.

What are, since the publication of M. Decandolle's "Essai sur les Propriétés Médicales des Plantes, comparées avec leurs Formes Exterieures et leur Classification Naturelle," (3d edit. Paris, 1816), the observations and experiments by which the theory exposed in that work may be confirmed and illustrated? What are the exceptions and contradictions which remain to be resolved with respect to that theory?

The coniferous trees differing considerably from other trees in their structure and mode of growth, as well as in the peculiar matters which they contain, and in other properties, there is desired—An exact comparison of the structure of the coniferous trees with that of other trees, and that, by ulterior researches, it be tried to demonstrate in what degree this difference of structure may serve, whether to explain the other properties of coniferous trees, or to deduce useful precepts for the cultivation of these trees.

In what manner do peat-ashes augment the fertility of some soils, while it is known to contain very little of those principles which chiefly serve as aliment to plants? Of what qualities are these soils, of which it is known by experiment that their fertility may be augmented by peat-ashes? To what soils are they injurious? What useful indications may be deduced from what will be said in reply to the two first parts of this question?

What is the origin of the blocks of granitic and other primitive rocks, which are met with of different dimensions, and in very great abundance, disseminated in the plains, and in some sandy deposits of the kingdom of the Low Country and of the north of Germany? Is it possible to be assured, by an exact comparison of these blocks of granite, and of the pebbles of the sandy deposites, with the component parts of geological formations observed in place, that the former originally formed part of the latter; and if this be the case, how can their transportation towards our plains and those of the north of Germany be explained?

The society desires that it be pointed out, as much as possible, what are the different places where these blocks have been observed, and in what manner they are found dispersed, that their nature and mineralogical composition be exactly described, that they be compared with the integrant parts of other formations; and, finally, that the consequences be scrupulously weighed, which may with more or less probability be deduced from the whole investigation.

The prize to be awarded to a satisfactory answer to any of the above questions, is a gold medal of 150 florins; and, moreover, a gratuity of 150 florins. The answers legibly written in Dutch, French, English, Latin, or German, but not in German characters, must be sent free of expence, with billets in the usual manner, to M. van Marum, perpetual Secretary of the Society.

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## *General View of the Geology of India.* By WILLIAM CALDER, Esq.*

"CASTING our eye over the map of India," says Mr Calder, "we are struck with the grand and extensive mountain ranges which form the principal boundaries. On the north we have the stupendous chain of the Himalaya, extending from the confines of China to Cashmeer, and the basin of the Oxus. That vast accumulation of sublime peaks, the pinnacles of our globe, is so extensive, that a plane, resting on elevations 21,000 feet, may be stretched in one direction as far as the Hindoo Cosh, for upward of 1000 miles, above which rise loftier summits, increasing in height to nearly 6000 feet more. Primitive rocks alone have been found to compose all that has yet been explored of the elevated portion of that chain; gneiss being, according to Captain Herbert, the predominating rock, along with granite, mica-schist, hornblende, chlorite-schist, and crystalline limestone. On these repose clay-slate and flinty-slate; and, towards the base, we find sandstone composing the southern steps of the chain, and forming the north-east barrier of the valley of the Jumna and Ganges, by which, and the diluvial plains of Upper Hindoostan, this great zone is separated from the mountain ranges of the peninsula. The opposite or southern boundary of this valley is of the same rock. Advancing to the south, we come to three inferior mountain ranges on which the peninsular table-land of India may be said to rest, or, more properly, to which it owes its peculiar form and outline. We may consider these ranges separately: the western, or Malabar; the eastern, or Coromandel; and the central, or Vindya. Of these, the principal in elevation, and most remarkable in continuity of extent, is the western, which may be said to commence in Candeish, and runs along the Malabar coast, within a short distance of the sea, in an unbroken chain, to Cape Comorin, excepting where it is interrupted, near its southern extremity, by the great chasm which forms the valley of Comibitoor. The direction of this chain deviates but little from north and south, bending a little eastward towards its southern extremity. Its elevation increases as it advances southward; the highest points being probably between latitudes 10° and 15°, where the peaks of granite rise to 6,000 feet and upwards.

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* At a meeting of the Physical Committee of the Asiatic Society, held on the 19th March 1828, Sir Edward Ryan, president, in the chair, a General View of the Geology of India, by Mr Calder, was read. The above account of part of this memoir, we extract from the Calcutta Government Gazette, which reports, in a very interesting and satisfactory manner, every scientific discovery and observation made in India. Already many important geognostical observations have been made in our great eastern empire, and we anticipate, from the labours of Dr Turnbull Christie, and other young and active naturalists, soon, we hope, to start for India, numerous additions to our knowledge of the natural history of this, one of the most interesting countries in the world.—EDIT.

The northern extremity of this range is entirely covered by part of the extensive overlying trap formation, to be more particularly described hereafter; extending, in this quarter, from the sea-shore of the northern Concan, to a considerable distance eastward, above and beyond the Ghauts, as far east and south as the river Tumboodra and Nagpore. These rocks assume all the various forms of basaltic trap, passing from the columnar (of which some fine specimens are to be seen opposite to Bassein, near Bombay,) into the globular, tabular, porphyritic and amygdaloidal; the two latter containing an unusual abundance and interesting variety of included minerals peculiar to such rocks. The landscape here exhibits all the characteristic features of basaltic countries; the hills rising abruptly in perpendicular masses of a tabular form, or in mural terraces piled on each other, and frequently separated by immense ravines; the whole clothed with luxuriant forests of teak and other trees, producing some of the most beautiful and romantic scenery of India. The elevation of this part of the range seldom exceeds 3000 feet; but, advancing to the south, its height gradually increases, and the granite rocks begin to reappear, continuing to form the summit of the chain, with little interruption, all the way to Cape Comorin. In nearly the same parallel of latitude, this trap formation is observed to terminate also on the sea-coast, a little to the north of Fort Victoria or Bancoote, where it is succeeded by the iron-clay or laterite (a contemporaneous rock associating with trap), which from thence extends, as the overlying rock, with little interruption, to the extremity of the peninsula, covering the base of the mountains, and the whole of the narrow belt of low land that separates them from the sea, exhibiting a succession of low rounded hills and undulations, and reposing on the primitive rocks, which occasionally protrude above the surface, as at Malwar, Melundy, Calicut, and some other points, where granite, for a short space, becomes the surface-rock. From the main land the laterite passes over into Ceylon, where it reappears, under the name of *Kubook*, and forms a similar deposit of some extent, on the shore of that island. Passing onward from the western or Malabar coast, round the extremity of the peninsula, we leave this extensive iron-clay formation behind, and, crossing the granite plains of Travancore, which are strewed with enormous blocks of primitive rocks, we arrive at the termination of the chain. Here the mountain-ranges, which support the central table-land, meet from both sides of the peninsula, and converge to a point, within about thirty miles of Cape Comorin, ending abruptly in a bluff granite peak of about 2000 feet high, from the base of which a low range of similar rocks, forming a natural barrier to the kingdom of Travancore, extends southward to the sea. The whole of this western mountain range, and the narrow coast which lines its base, is remarkable for the absence of rivers and valleys of denudation, and consequently of alluvial plains or deposites. The abrupt precipitous sides of the mountains, rising almost perpendicularly from the sea, are nevertheless covered, in general, by forests of the tallest trees, and impenetrable jungles, which admit of gaining but a vague and scanty knowledge of the mineral treasures with which they probably abound, if we might be allowed to draw inferences, from the striking analogy, in geological feature and outline, between the mountain-ranges and western coast of the South American Continent and that just described, in some of which traces of copper, gold, silver, and other ores, have been found.

Proceeding on to the eastern side of the peninsula, and northward along the foot of the mountains, we observe a country differing very considerably from the Malabar coast in appearance and geological character. The plains of the Coromandel coast form rather a broad, though unequal, belt of low land between the mountains and the sea, exhibiting the alluvial deposites of nearly all the rivers and streams that descend from the southern portion of the table-land. The mountain-chain that forms the eastern boundary of the peninsula, after a short northerly course from Cape Comorin, begins to diverge to the east, near where the great valley of Coimbitoor (already mentioned) interrupts its continuity. From thence it breaks into a succession of parallel ranges, inferior in elevation and in unbroken continuity, to the western chain, and, in the further progress northward, after breaking off into subordinate hilly ranges, occupying a wide tract of unexplored country, and affording valleys for the passage of the great rivers that drain nearly all the waters of the peninsula into the bay of Bengal. This eastern range may be said to terminate at the same latitude as that of the commencement of the western. Granite rocks, and principally sienite, seem to form the basis of the whole of these eastern ranges, appearing at most of the accessible summits from Cape Comorin to Hydrabad. Gneiss and mica-slate, that form the sides and base of the mountains, are sometimes seen, as also clay-slate, hornblende-slate, flinty-slate, chlorite, and mica-slate, and primitive or crystalline limestones, affording, in some places, marbles of various colours, as in the district of Tennivelly, where also granite appears rising above the surface, in remarkably globular concretions, and in perfectly stratified masses, forming low detached hills near Palemcotta, the strata of which dip at an angle of about 45° to the south-west. Partial deposites, too, of overlying rocks exist in this district, and of the black-cotton soil, which is supposed to be produced by the debris of trap. In the neighbourhood of Pondicherry there are beds of compact shelly limestone, and some remarkable siliceous petrifactions, chiefly of the tamarind tree, which have never yet been well described. The beds of the Cavery, or rather the alluvial deposites in the vicinity of Trichinopoly, produce a variety of gems, corresponding to those of Ceylon. In general, however, the surface of the level country, as far north as the Pennar river, seems to consist of the debris of granite rocks, and plains of marine sand, probably left by the retreat of the sea; with occasional fresh-water alluvial deposites, and partial beds of iron-clay, and detached masses of the overlying class. In approaching the Pennar river, the iron-clay formation expands over a larger surface, and clay-slate and sandstone begin to appear. On the hills behind Pellore are found specimens of a very rich copper-ore, yielding from fifty to sixty per cent. of pure metal, according to Dr Heyne, besides argentiferous galena.

It is to the observations of Drs Heyne and Voysey that we owe all the information we yet possess of the valleys of the Pennar, the Kistna, and the Godavery rivers. This interesting tract of country is not more remarkable as the ancient source of the most valuable productions of the mineral kingdom, being the repository of the Golconda diamonds, than for the extraordinary geological features which it presents. The Nella Malla range of mountains, in which the diamond breccia is found, is described, by Dr Voysey, as exhibiting a geological structure that cannot easily be explained by either the Huttonian or Wernerian theories; the different rocks being so mixed together, with regard to order of position, each in its turn being uppermost, that it is difficult to give a name to the formation that will apply in all cases. The clay-slate formation is the name he has adopted, under which are included clay-slate, every variety of slaty-limestone, sandstone, quartz rock, sandstone-breccia, flinty-slate, hornstone-slate, and a tufaceous limestone, containing imbedded in it fragments, round and angular, of all these rocks, all passing into each other by such insensible gradations, as well as by abrupt transitions, that they defy arrangement, and render description useless. It is bounded on all sides, however, by granite, which passes under it and forms its basis; some elevated points, such as Naggery Nose, having only their upper third composed of sandstone and quartz, while the base is of granite.

The rocks above enumerated, with the addition of the iron-clay and basaltic rocks, occupy extensive portions of the valleys of the Kistna and Godavery, covered in some places by the black trap soil. The granite rocks, on which they rest, are often penetrated, and apparently heaved up, by injected veins, or masses of trap, and dikes of greenstone. Mr Calder hopes soon to be enabled to lay before the society a detailed description of the curious formations, accompanied by sections of the strata, between Madras and Hydrabad. The waters of the Kistna and Godavery expand as they approach the sea, dividing into numerous branches, and depositing their alluvial contents, during inundations, over a considerable extent of land bordering the coast. The largest portion of deposites consists of decayed vegetable matter, yielded by the extensive forests through which they flow; and here may be noticed the characteristic difference that marks the alluvial deposites of the principal river of the south, the Cauvery. This river, flowing in a long course through the Mysore country, over an extensive and generally barren surface of granitic and sienitic rocks, with scarcely any woods or jungle on its banks, brings down little or none of decayed vegetable alluvium; but a rich yellow clay, produced by the felspar, which predominates in the granites of Mysore and the south, and which, mixed with carbonate of lime, renders the plain of Tanjore by far the most fertile portion of the south of India. Passing on to Vizagapatam and Ganjam, the granite rocks appear occasionally covered by laterite. The granite of Vizagapatam assumes a new and singular appearance, being small-grained, and intimately intermixed with amorphous, or uncrystallized garnets, in round grains or specks. This peculiar rock passes into the province of Cuttack. The only information we possess regarding that interesting district, is derived from Mr Stirling's valuable paper in the last volume of the Asiatic Society's Researches. The rocks of the granite class form the basis and predominant elevations of this district. They are remarkable for their resemblance to sandstone, and abounding in imperfectly formed gauts, disseminated throughout with veins of steatite. Here, too, traces of coal have recently been discovered, which is likely to be productive; and gold is frequently found in the sands of the Mahanuddee, probably from the valley of Sumbulpore. We next trace the laterite, increasing in extent all the way to Midnapore, and thence continuing northwards by Bissunpore and Bancorah to Beerboom.

We must pause here, and take another opportunity to resume Mr Calder's comprehensive essay on the geology of India.

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## *On some New Bodies which strongly absorb Light.* By M. Osann.

The phosphorescent bodies prepared by M. Osann, are the following:—1. *Phosphorus of Antimony.* To obtain it, calcined oyster-shells are taken, of which the whitest and most porous are selected. After freeing them of all impurities, they are put into a crucible in the following manner:—The bottom of the vessel is covered with a finely pulverized sulphuret of antimony; there is then placed a shell, which is covered with a new layer of the same powder, then a second shell, and so on, until the crucible is filled. To distribute the powder equally, a small sieve should be used. Each layer must be about two lines in thickness. The crucible is then closed, and exposed for an hour to a red heat. The upper shells, and those at the bottom, which are commonly spotted, must be rejected. When the phosphorus thus obtained is exposed to the solar light, and then taken to a dark place, it shines with a greenish-white light, and is superior to Bologna phosphorus, both in the intensity and in the duration of its light. This greenish glow, of a pistachio colour, which is characteristic, is the same in all points of the phosphorescent body. By a red heat, continued for a long time, it is lost, and is then replaced by a white light.

2. *Phosphorus of Realgar.*—This is prepared in a similar manner, the calcined shells being treated with red sulphuret of arsenic. It produces a blue light, resembling the flame of sulphur. As in the preceding phosphorus, the perfectly white

places alone are phosphorescent. This phosphorus, on that account, presents here and there points which shine with a purplish red light. If it is exposed for a long time to an intense heat, its light is discoloured, and ends with becoming entirely white.

3. *Phosphorus of Arsenic.*—To obtain it, a kind of paste is made of arseniate of barytes and gum-adragante, which is exposed for half an hour to a red heat. Thus prepared, this phosphorus presents a greyish-yellow aspect, nearly the same as that of Bologna phosphorus; it diffuses a red light in the dark; but if it is heated longer than half an hour, its colour becomes yellow; and under a longer heat, it ultimately becomes white.

These three kinds of phosphorus are very luminous compared with the following, which possess that property in a much less degree. The dimmer phosphori are prepared in the same manner as the phosphorus of antimony. The shells of oysters, with mussive gold *, yield a phosphorus emitting a feeble bluish light. With cinnabar there is obtained a phosphorus whose light is yellow, nearly like that of Canton's phosphorus. With white oxide of arsenic there is produced a bluish-yellow phosphorus; and with a very finely pulverised mixture of blend and sulphur, a bluish phosphorus is obtained. The authors obtained a very beautiful phosphorus, by treating Canton's phosphorus with realgar.

All these compounds are kept in sealed vessels, or such as are closed with a piece of bladder. They keep pretty long in the open air; for, at the end of three weeks, they had scarcely lost any of their phosphorescence. It is only when the lime falls into powder that their light is impaired. The phosphori of antimony and realgar, however, lose the intensity of their colour, when they are long exposed to the light. It is therefore a good plan to keep them in blackened flasks.

Phosphorus of arsenic is composed of equal parts of arsenic and barytes, as Bologna phosphorus is of equal parts of barytes and sulphur, and Canton's phosphorus of equal parts of lime and sulphur.

Cold favours the absorption of light, as heat favours its dispersion. Boiling water destroys the phosphorescence. Phosphoric bodies, that have remained in darkness, long after their preparation, are not luminous. On being exposed for a minute to the solar light, they shine for a greater or less time; Bologna phosphorus for 4 minutes, that of arsenic 34 minutes, and phosphorus of antimony 149 minutes. At the end of this time, the phosphorus of realgar was still as luminous as it was an hour before. After being exposed to red heat for several hours, and then to light, the phosphorus of arsenic shone in the dark in the same manner as before; that of antimony had only a feeble glow, and the phosphorus of realgar was destitute of light.

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* Mussive gold is bisulphuret of tin.

If an electric spark be made to pass an inch above these different phosphori, they become luminous, with the same shades of colours as if they had been exposed to the light. The phosphori reflect their light while exposed to the day; but it is then only a white light; the coloured light is reflected only in the dark. The light to which they are exposed during their preparation is not communicated to them, as they do not absorb light at an elevated temperature. If they are only exposed to a feeble light, they only acquire a slight phosphorescence. From all these observations, the author admits, with M. Grotthus, that there is a true absorption of light. Each phosphorus, according to him, would have a certain capacity for that fluid.

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## *On the Modes of Preserving the bodies of Animals in Fluids of different Kinds, particularly during Voyages and Travels.*

Immediately after the cessation of life, animal and vegetable bodies are affected by an internal motion, named putrefaction, which tends to separate and reduce to their original elements the ingredients of which they are composed. Various methods have been devised to prevent this process, among which immersion in fluids is the most important. Of these fluids, the following are those more commonly employed: 1. Aqueous fluids, instead of preventing putrefaction, accelerate it; and therefore can only be used for washing the substances to be preserved previously to their immersion in other fluids. Water in which alum is dissolved, has indeed a constringent effect upon the animal fibre, but its action is so feeble, that important results cannot be expected from it. Water slightly impregnated with salt, is employed only for the preservation of fruits. 2. Spirit of turpentine, which is sometimes employed, changes the texture, and has the additional inconvenience of becoming thick and viscid. Its use ought therefore to be rejected. 3. Oils may be used for preserving certain soft animals, such as fishes. 4. Brine, consisting of water, saturated with salt (muriate of soda), is accused of altering the forms and colours of objects. Fishes that have a thick skin, however, answer well enough in it; and it is useful for the preservation of large skins of other animals. 5. Acids destroy the texture of parts, or effect alterations in them, by coagulating the albumen, and dissolving the gelatine. Common vinegar, however, especially when saturated with common salt, and impregnated with pepper or pimento, is employed with success in the preservation of objects of natural history. 6. Red wine, into which there has been poured some nitrous solution of mercury, may be employed by navigators when nothing better is at hand. 7. The effects of pyrolignous acid have not yet been sufficiently determined, although there is reason to believe that it will yet furnish a most effectual preservative. The same remark applies to the sulphurous acid recommended by Dr John Davy, which, in his opinion, is superior to any other fluid for the preservation of objects [*]. 8. Alcoholic or spiritous liquors are the substances most commonly employed for the preservation of objects of natural history not of a large size; and they are, at the same time, the most efficient. The best of these is the alcohol obtained by the distillation of wine. Arrack, tafia, rum, whisky, gin, &c. which navigators can easily procure in the countries where they are used, although apparently possessing the same properties as spirits of wine, are yet much inferior to it as preservatives. It is obvious, however, that the liquors which can be most easily procured in the countries which produce them, ought to be in general preferred, both on account of their abundance and of their moderate price. Those which have fewest of the principles inherent in the substances from which they are produced ought to be preferred.

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[*] Medico-Chirurg. Trans. vol. iii. pt. i. p. 230.

Alcoholic fluids, however, have the disadvantage of hardening the tissues and changing their nature. This property is, in some measure, corrected by proportioning the strength of the fluid to the size of the animal or object to be preserved. The more transparent they are, the more are they fitted for collections; the more concentrated, the more destructive they are of the colours. The weaker, therefore, they are the better, provided their strength is sufficient for the preservation of the objects.

Pure alcohol destroys the animal colours; and, when highly concentrated, disorganizes the tissues. These qualities, however, are corrected by adding acids to it. Diluted with water, and consequently weakened, these liquors appear to possess a less favourable action than the spiritous, which naturally equal the factitious strength that has been given them. It will be kept in mind, that alcohol becomes milky when diluted with common instead of distilled water. In general, it is sufficient to employ an alcoholic liquor of the strength of from 16 to 22 degrees of Beaume's areometer, proportioning it to the size and penetrability of the object. For large animals, the most concentrated liquor is to be employed. If spirit of wine cannot be procured, the ordinary strength of the liquors substituted for it may be increased by adding dissolved camphor, which, without increasing their spiritous power, imparts a degree of energy sufficient for the preservation of animals. This mixture has the advantage of not acting upon the colours. A combination in the following proportions appears to be the most suitable for soft animals: pure water, two parts; alcohol, one part; sulphate of alumina, two ounces for every litre of fluid.

Guyot's liquor, possessing a considerable reputation, may be mentioned here for the benefit of persons residing in the colonies who may be disposed to use it. Take twenty pints of the best Cogniac brandy, from which distil five pints of spirit; then add to what remains equal parts of well-water, and a pound of flowers or leaves of green lavender; distil again to dryness. This done, take eleven parts of the spirit of wine obtained by the first distillation; mix them with sixty-nine parts of well-water, and add to this mixture equal parts of the liquor furnished by distillation. There is thus obtained Guyot's preserving liquor, which is perfectly limpid, has a slightly bitter taste, and a somewhat aromatic smell; and does not contain more than one part of alcohol for every thirteen of water. Dr Monro added nitric or muriatic acid, in small quantities, to the liquors which he employed. The celebrated Ruysch made use of spirit of wine, distilled with black pepper, cardamom and camphor.

Before immersing the objects, they ought to be well cleaned and reduced to order in water, at a gentle temperature. They ought especially to be cleared of salt water,—a process which requires to be particularly attended to in the crustacea, which, without this care, would irremediably spoil. The immersed objects must be incessantly watched, the liquors must be renewed when they have leaked or evaporated, and the stoppers must be carefully fitted. On voyages strong glass bottles of a square shape are preferable to round ones, because they can be better fitted into cases with corresponding compartments.

The inconveniences resulting from leaving animals, intended to be preserved, in liquids, to their own weight, are the following. The mucus, food and excrements which detach themselves from the animal, accelerate its corruption. Reptiles, fishes, &c. tending to fall to the bottom of the vessel, have then some of their parts withdrawn from the action of the alcohol, or enveloped with a thick layer of mucus, and are thus more liable to be affected by putrefaction.

Dufresne in his Taxidermy has described a method which answers very well on voyages. Spiritous liquors, he says, are preferable to all other means for preserving animals; and he recommends putting as many fishes as possible in them. On long voyages, a number of small casks with iron hoops should be employed. An aperture being made at one end, six inches in diameter, one of these casks is filled for two-thirds only with spirits. When a fish is to be preserved, notes are taken with respect to the individual, the place where it was procured, whether it be male or female, good or bad for food, &c. This done, the fish is enveloped in a bit of cloth. There is then attached to it a small wooden label, on which the number is marked with a knife in Roman characters, corresponding to the number attached to the notes. The fish is then deposited in the cask, and the aperture closed. When the roe is large, it ought to be removed by an incision made in the belly. When a layer of fishes has in this manner been deposited, it is covered by a layer of cotton or tow, to prevent the fishes from being damaged by the rolling of the vessel. In general, the cask should only contain two-thirds of fishes, the rest of the space being occupied by cotton or flax.

The principal objections to this method is, that it does not completely guard against the putrefaction of the fishes, especially in warm climates. Peron proposed another method, which he found perfectly efficacious, and which is as follows: The animal is to be washed before immersion in spirit, in sea water, vinegar, rum, tafia, or camphorated spirits, according as these substances may be most easily procured. The mucosities are to be removed by a hair brush. The animals are then suspended in the fluid, but they are so suspended that they can float at the surface, which is managed by attaching pieces of cork to them. In some cases, round plates of cork are taken, and the animal fastened round its edge, by means of brass wire or pins. Reptiles require an additional means, which consists in forming cork spirals, into which the bodies of serpents are made to pass. Inclosed in this manner, and bathed on all sides by the alcohol, these animals are perfectly preserved. Incisions are to be made in the belly of large animals, in order to admit the alcohol to the viscera, but the latter ought not to be removed, or if this is necessary, they must be separately preserved, as they are of the greatest importance for the study of the organization. The individuals are all numbered, and a corresponding mark attached to their descriptions.

A little practice will soon enable any one to manage these details with facility, and although they may be at first somewhat troublesome, the labour is amply compensated by the advantages gained: Animals thus put up, can experience no damage from the rolling of the vessel, or from the excessive heat of the Torrid Zone.

Various means for closing the vessels have long been used, which we shall now point out. Peron finding many of them insufficient, substituted others which he found to answer his wishes. Parchment, covered with a solution of sealing wax in pure alcohol, has long been used; but parchment is readily reduced to a putrid state by humidity and heat, and wax is softened by contact with the alcohol, and allows the latter to evaporate. The following preparation has been used with more success. It consists in soaking the cork for some time in a composition of three parts of wax and one of tallow, kept fluid by a moderate heat. It is then covered with a flexible envelope, which penetrates its pores and prevents evaporation. The stopper is also sometimes covered with a mastich made of four parts of pitch, one part of sulphur, and a half part of tallow, well melted together. This covering is applied hot. Dr Sue employed the following method: He placed a round plate of glass on the mouth of the bottle, put a piece of oiled parchment over it, covered the parchment with a bit of sheet-lead, over which he applied a second piece of parchment soaked in oil coloured with lamp-black. He then tied the whole with a small cord as tightly as possible.

The following are the means recommended and employed by Peron,—to prefer cork-stoppers to glass-plates, which are easily broken, and to employ a luting easily made, instantaneously drying, and capable of resisting the shocks given by the rolling of the vessel, as well as the evaporation of the alcohol. This luting consists of common resin, red ochre, yellow wax, and oil of turpentine, in variable proportions, according as the luting is wished to be hard or soft. The manner of preparing it is as follows: The resin and wax are first melted; the ochre is then added in small quantities; the mixture is well stirred with a spatula, and the whole allowed to boil for seven or eight minutes. The turpentine is then added, and the boiling allowed to go on. To obviate the danger of the mixture taking fire, a vessel is used capable of containing at least three times the quantity, and furnished with a handle, so that it may be easily taken off. Should the substances happen to take fire, the vessel is to be covered with a lid made of wood, tin, or copper, by which the flame will be instantly extinguished.

This luting is employed as follows: The cork is exactly fitted to the aperture, which is wiped dry with a cloth; the luting is heated to a degree approaching to ebullition; a coarse brush is made with a piece of linen; the mixture is stirred to prevent the ochre from sinking to the bottom, and a little of it taken up with the brush and applied upon the outer surface of the cork.

The application may be repeated as often as is judged necessary. A piece of linen is then applied over it, and above this, several folds of linen soaked in oil or pitch, which are tied to the neck of the bottle with pack-thread *.

## *Some Remarks on the Temperature of Springs.* By Baron LEOPOLD VON BUCH.

WE owe to Wahlenberg, says Von Buch, in an interesting memoir on the temperature of springs, read to the Royal Academy of Sciences of Berlin, (published in Poggendorf's excellent Journal,) the discovery of a beautiful arrangement in the economy of nature, viz. that the mean temperature of the soil and subjacent rock rises higher and higher above that of the air, the further we advance towards the north. By this means, polar situations support a number of vegetables, which otherwise would perish, nay, even life itself is thereby brought into places which would be dead and arid, and from which every living thing would flee. Who can conceive agriculture and cultivation, in a soil where temperature is 1° or 2° R. below the freezing point? But the temperature is actually not higher in places in which there are towns, and where corn is raised with activity and profit. It is the temperature of a great part of Siberia, and of many inhabited valleys in Sweden.

The observations of Wahlenberg, from which this remarkable result proceeds, Von Buch communicated to the public in a tabular form, in Gilbert's Annals, and compared with the temperature of the atmosphere. From this table we extract the four following results, which represent perfectly the nature of the phenomenon.

| | | Tempr. of Spring. | Tempr. of Atmosph. | Difference. |
|---|---|---|---|---|
| At Carlscrona, - | 56°½ N. Lat. | 6.8 R. | 6.3 R. | 0.5 |
| Upsal, - - | 60 | 5.2 R. | 4.45 R. | 0.75 |
| Umea, - - | 64 | 2.3 R. | 0.6 R. | 1.7 |
| Giworten Fiall 1600 feet above the sea, - | 66 | 0.96 R. | —3.0 R. | 3.96 |

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* The above details are extracted from an article on the preservation of animals, in the last published volume of the *Dictionnaire Classique d'Histoire Naturelle.*

Von Buch remarks, Wahlenberg and also other philosophers search for the cause of this phenomenon in the protecting cover of snow, which, by reason of its feeble conducting power of heat, prevents the winter's cold sinking into the earth. This opinion rests on the erroneous assumption, that the heat of the atmosphere penetrates into the soil and subjacent rocks, by communication through their mass. The observations of Saussure, by which it was proved that heat did not penetrate to a greater depth than thirty feet in the space of six months, shew how slowly such a mode of distribution takes place; and observations made afterwards in a spring at Geneva, and continued for ten years, shewed, that, in it, the minimum temperature occurred when the greatest heat prevailed in the atmosphere, and the maximum at the time of the greatest cold. We can scarcely believe that the cover of snow would be sufficient to interrupt, during its long continuance of several months, the radiation of the heat of the soil. Besides, as the influence of two unequally heated bodies is always reciprocal, it follows, that, in the course of a year, even the best non-conducting cover would not prevent the soil and rock from acquiring the medium temperature of the atmosphere.

It is also not easily understood how northern situations should be more protected from such radiation than southern ones, when it is known that the quantity of falling snow diminishes with the increase of latitude; and hence the snow-cover becomes less considerable. We observe, with surprise, that Professor Leslie also believes in this communication of heat through the soil, and endeavours, but unsuccessfully, to adduce in favour of this opinion, experiments made at Raith, with thermometers placed at different depths in the soil.

It is therefore necessary to repeat, continues Von Buch, how this law is modified, and completely concealed by the agency of a more active one; namely, how this distribution can depend almost entirely on the infiltration of *atmospheric water*, by which the temperature is distributed so quickly through the soil and into the deep, that the immediate effect, by means of mere communication, must be overcome at an inconsiderable depth, and at length become completely insensible.

Hence the great winter cold of the north acts so slightly on the soil, and, with the greater difference, the lower the temperature; because no water flows in the winter time, and a temperature below the freezing point cannot be conveyed by this quickly circulating medium. I am therefore convinced, says Von Buch, that all statements which maintain that the soil, at the depth of many feet, is found frozen, even during the summer, in places which are able to support shrubs, are to be viewed as unsatisfactory.

In those situations where the cold is not sufficient to hinder the circulation of water, the temperature of perennial springs is almost identical with that of the atmosphere. Thus, in the vicinity of Edinburgh, the temperature of the perennial springs agrees with the mean temperature of the atmosphere. The same is the case in the whole of Atlantic Europe, and also to a great extent in Southern Europe.

But Humboldt was the first who discovered that this arrangement does not hold in the warmer countries, where the temperature of the springs is almost always some degrees below that of the superincumbent atmosphere. This phenomenon commences in the south of Europe; for Von Buch found a spring at St Cesareo, near to Palestrina, at Rome, on the 20th August, at 9½° R.; the temperature of the atmosphere 22° R.; and the mean temperature 12.6° R. He also obtained the following results from springs in the Canary Islands:—

*Teneriffe.*

| | | |
|---|---|---|
| 1. Spring near Puerto Orotava, | 14° | 2′ R. |
| Mean temperature of atmosphere, | 17 | 3 |
| 2. Spring of El Rey, near to Orotava, on 8th May, | 14 | 3 |
| 3. Same spring, 7th June, and 6th September, | 14 | 8 |
| 4. 1st June, fine spring near to Rialejo, | 13 | 3 |
| 5. Same spring, on 8th September, | 11 | 1 |

*Palma.*

| | | |
|---|---|---|
| Water of a deep well on 8th September, | 15 | 77 |

*Lancerote.*

| | | |
|---|---|---|
| Temperature of a well, | 14 | 11 |
| The mean temperature of the soil from the above, will be, | 14 | .4 |

From these observations it appears, that the temperature of the springs in these islands is three degrees lower than the mean temperature of the air.

However remarkable this cooling or low temperature may appear, when examined, during summer, we can easily satisfy ourselves that it arises from no other cause than that which warms the rock and soil of the north.

From Southern Europe to the Tropic there is but one rainy season, which continues from November until April. In this great tract, no rain falls from the month of May onwards. Hence, as little of the summer heat will be distributed through the soil, and subjacent rock, by means of percolating water, as of the winter's cold in frozen districts. It is only that temperature, which the rain already meets with at the period of its fall, which it carries along with it to the interior, and the springs issue forth with this temperature. Hence the heat of the springs at Orotava is probably the mean of the months of February and March.

From observations on springs in Grand Canary, it results, that the temperature of the rock or soil for the northern declivity of the island is about 13¼° R., while the mean of the atmosphere is 18° R. These, and other similar facts, mentioned by Von Buch, seem to warrant the conclusions, that the temperature of springs in northern regions, where the surface water is frozen, is higher than the mean temperature of the superincumbent atmosphere; that in temperate regions, where the surface, and consequently the percolating water, is not frozen, the temperature of springs is that of the mean of the atmosphere; 3. and *lastly*, that, in the countries from the south of Europe to the Tropic, the temperature of springs is lower than that of the medium temperature of the atmosphere.

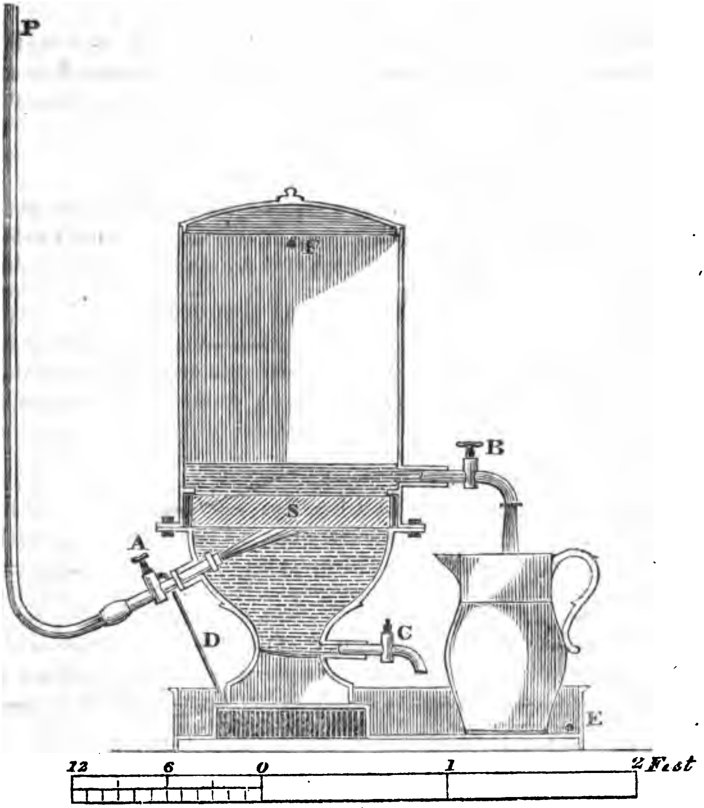
## *Account of a New Method of Filtering Water, invented by* JAMES WHITE, *Esq. Engineer.*

THE filtration of water in a mountainous country like Scotland, where water is in general pure, is comparatively a subject of less interest than in flat and fenny districts, or in great cities like London, which is supplied chiefly from the collected waters of the Thames. The means of purifying water under such circumstances, is a matter of the first importance to the health and comfort of the community.

It is well known that, till of late years, the want of good water has been severely felt in the lower parts of Lincoln, Kent, and other fenny districts. In some of these, where the inhabitants and their cattle suffered much from the want of good water, the evil has lately been removed where this essential necessary of life has been supplied by means of perforations made to a great depth in the soil, by boring with an iron augre, so as to reach and bring to the surface the deep-seated springs.

In the metropolis, every one knows the great outcry which has of late been made about the polluted state of the Thames water for domestic purposes, arising from this river being the receptacle of the drainage waters of that overgrown city. In point of fact, (as noticed by our distinguished countryman Mr Stevenson, engineer), the waters of the Thames are changed or renewed very slowly, nearly the same body of water moving upwards and downwards as the tide flows or ebbs. The inhabitants of London, therefore, may actually be said to be receiving into the stomach what had formerly passed through the public drains. This has become a subject of so much notoriety and interest, that Government has of late made it a matter of public inquiry, and has procured the report of a committee of professional men, consisting of a physician, a chemist, and a civil engineer. The effect of these movements has been to produce numerous plans for supplying the city from a purer source, and also for filtering the water which it already possesses. Among these may be mentioned a plan by Mr James White, engineer, of Oxford Street, London, and another by Messrs Stirling and Son of Lambeth, who have invented a machine called the "Rapid Filter," and obtained a patent for it. Having no drawing of Messrs Stirling's apparatus, we shall at present confine ourselves to a notice of Mr White's "Patent Artificial Spring," as given by himself.

When new inventions, which promise to be of public utility, present themselves to our notice in a simple form, a degree of surprise is excited, that they should hitherto have eluded the research of ingenious men, whose lives have been devoted to mechanical pursuits. It is certain there are but few things of greater importance to the comfort of every family than water, which shall be good in quality, and provided in sufficient quantity for all the purposes of domestic use. That both these effects are produced by this invention, will be best shown by a description of the annexed diagram, and an account of the experiment, as tried at the house of the nobleman who was the first to patronise the design. The figure, as shewn in the diagram, is a section through the centre of the machine, which shews the whole of its interior construction. The cistern containing the water is not introduced, as its height would exceed the limits of the diagram; but let the small pipe P be supposed to communicate with it, and be of any length, from 10 to 100 feet: it is, however, necessary to bear in mind, that the quantity filtered will always be proportioned to the area of the stone multiplied into the height of the column or pipe. The advantage, therefore, of employing a high cistern to supply the machine, requires no other recommendation.



Three years ago, in the south of Russia, in the government of Poltava, when, on a mission appointed by the late Emperor to examine the mechanical and agricultural state of that part of the Russian empire, it fell to my lot to give a design for filtration on a large scale. To effect that object, I introduced the water to be filtered below a bed of sand and gravel: it was intended for the purpose of washing wool, consequently did not require that purity produced by this invention. But at the house of the nobleman I have already alluded to, I attached a half inch leaden pipe to a cistern, which was already fixed thirty-five feet above the ground-floor, where I placed the machine. The other end of the pipe I made water-tight, by fixing it to a nozzle in the apparatus, below a proper filtering-stone. Upon turning the cock A, which shuts off the communication betwixt the machine and the cistern, the water rushed down from the cistern with great force, and very soon displaced all the air contained in the apparatus through the pores of the stone S; after which the water began to ascend, and to flow in a filtered stream at the cock B, so as to fill a gallon measure in about two minutes' time. Its appearance in small bubbles, rising through every pore in the stone, from the great pressure of the column of water contained in the small pipe P, suggested to me the name which I have given it, of an artificial spring; and further experience has fully convinced me, that I have not applied to my invention an unmerited title. From the construction of the apparatus, the sediment and animalculæ will fall to the bottom, and be drawn off at the under cock C, and run off by the waste-pipe E. In cases where several gallons are wanted at the same time, and it might be inconvenient to wait until it be filtered, shut the cock B, leave A open, and in a few minutes, with a pressure from a cistern of thirty feet high, eight or ten gallons will be found filtered in the top part of the apparatus, which can be drawn off at B for immediate use, as required. Should it filter more than the top reservoir contains, while A remains open, it will run off waste at F; the cock A can be so constructed as to shut of its own accord, but in this case the machine would not be so simple. The cock A is of a peculiar construction, and well merits the attention of the reader: at the same time that it shuts off the communication betwixt the machine and the cistern, it opens, when turned one way, through the tube D, a small passage to the atmosphere. By this contrivance, the filtered water in the top part of the machine is allowed to subside the contrary way through the stone, a process which must naturally tend to wash its pores clean; and we know that all filtering substances are subject to get clogged up, from particles of fine sediment lodging in their pores. But what back filtration does not remove in my invention, another beautiful and simple phenomenon completely effects. Open the under cock C, and then shut it again as fast as possible: this will produce an immense pressure on the stone, and the water will be forced through with so much rapidity as to clean its pores completely. From what cause, I have not yet been able to ascertain, but it invariably happens, after the process of forcing the air through the stone, that the power of filtration is diminished considerably, and it is several hours before its power is restored. It may be presumed that the air lodges in the pores of the stone, and shews considerable obstinacy in being removed. When back filtration is not required, for it is only necessary for keeping the stone clean, the cock A must be shut off, with the notch in the top of it towards the machine, and the filtered water can be retained in the top part of the apparatus for any length of time. Having briefly described the nature of my invention, it remains for me to add, that it is an application of the Hydrostatic Paradox to the filtration of water, the nature of which admits of its being extended to any magnitude. For example, at the house where my first experiment was tried, the altitude of the cistern was 35 feet, and the area of the stone contained 113 square inches, which sustained an upward pressure from the column of water in the pipe P of 1853 pounds, and the product of filtration was at the rate of half a gallon per minute; and since the altitude of the pipe into the area of the stone proportions the quantity, it is a simple question to find what area and altitude together would produce 10, 20, or 100 gallons of filtered water every minute. To produce such effects, a number of stones must be used in the same machine. I believe it yet remains to be proved whether filtered water preserves as well at sea as that which is not filtered. I conceive it will be found to keep equally well, or perhaps better, as filtration removes all animal and vegetable matter which it holds in suspension, the former frequently both in a live and putrid state, a circumstance which cannot reasonably have any tendency to preserve water. Should experience prove that my hypotheses are correct, I would propose, for the benefit of the public in general, and the shipping interest, that a machine on a large scale should be erected at every sea-port, where ships are in the practice of taking water, which should be sent at once filtered to sea.

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## *Description of several New or Rare Plants which have flowered in the neighbourhood of Edinburgh, and chiefly in the Royal Botanic Garden, during the last three months.*

10*th Dec.* 1828.

### Begonia insignis.

B. *insignis;* subherbacea; caule erecto, ramoso, nodoso, glabro; foliis longe petiolatis, inæqualiter cordatis, acuminatis, obsolete lobatis, duplicato serrato-ciliatis, supra sparse strigosis, subtus subrubris, glabris; stipulis lineari-triangularibus, acuminatis, integerrimis; pedunculis terminalibus, nutantibus, bis terve dichotomis, multifloris; capsulæ ala maxima acuta, reliquis obtusis.

Description.—*Stem* erect, subherbaceous, entirely free from hairs, but rough and brown, swollen at the joints. *Branches* erect, smooth, shining, subpellucid, reddish, and with a few white oblong spots. *Leaves* alternate, on smooth shining petioles, which are nearly round, and half their own length, unequally cordate, acuminate, slightly concave, pale green, and sparingly strigose above, paler green, or red, and always naked below, obscurely lobed, and doubly serrato-ciliate, crisped, especially when young. *Stipulæ* linear-triangular, narrow, acuminate, entire in the edge, pellucid, and nearly colourless, submarcescent. *Peduncles* terminal, twice or thrice dichotomous, nodding. *Bracteæ* cordato-ovate, keeled, reflected at the sides, a pair being placed at each bifurcation of the peduncle, caducous. *Flowers* monœcious, large, rose-coloured, very handsome. *Male;* one standing in each bifurcation, on a peduncle above two inches long, and having in the ultimate division a female flower on each side, unless, as is not unfrequent, one of the females proves abortive; *corolla* tetrapetalous, two of the petals large (¾ths of an inch in either diameter), cordato-subrotund, and slightly pointed, the two others nearly as long, but much narrower, spathulate; *stamens* about 40, yellow, monadelphous; anthers bilobular, wedge-shaped, somewhat flattened; pollen yellow. *Female; corolla* smaller than in the male, generally of five obovate, somewhat irregular, unequal petals, occasionally only four; *style* greenish-yellow, stout, 3-parted, diverging, enlarging and flattened towards the *stigmata*, which are large, revolute, glandular, each with two ascending angles, bright yellow; germen pale green, with three very unequal wings, the largest acute, the second rounded, the smallest obtuse angled, tri-locular, placentæ double in each loculament, waved, extending from the central column, to which they are attached, to the angles, throughout the whole length of the capsule, and everywhere densely covered with minute ovules. The male flowers expand first, and one of the females before the other, on the same division of the peduncle.

We received a plant of this beautiful species from the Botanic Garden, Berlin, in spring last, under the name of *Begonia ciliata*, but it differs entirely from the description of that species by Kunth, and I think from every other which is recorded. Its foliage is not equal to *B. argyrostigma*, nor the appearance of its stem to *B. dipetala*, but it surpasses these and perhaps every other species in cultivation, in the gracefully drooping clusters of its large, bright rose-coloured flowers. It adds greatly to its value that it flowered most freely in the stove during December. I regret that I cannot state from what country it was introduced into Europe.

## Bromelia cruenta.

B. *cruenta;* foliis postice glaucis, ecarinatis, serrato-spinosis, obtusis, mucronatis, apice cruentis; spica terminali, conferta, subsessili in cyatho foliorum; calycibus acuminatis, nitidis; bracteis obtusis, cucullatis, viridis.

Description.—*Plant* probably parasitic. *Stem* short, ascending, cylindrical. *Stolons* axillary, sheathed with large, imbricated, ovate, adpressed, entire scales. *Leaves* (1½ to 2 feet long, 3 inches broad,) numerous, imbricated, erect at their base, spreading above, linear, obtuse, mucronate, serrato-spinous, very hard and rigid, bright green and concave above, pruinose in transverse stripes and rounded below, sprinkled irregularly with blood-red stains, and marked with the same colour on the anterior surface for above half an inch at the apex, greatly dilated at their base, and forming a cup, from which water thrown upon the plant does not escape. *Spike* terminal, capitate, bracteate, but without coma, nearly sessile, and raising only its upper surface above the water which the cup formed by the leaves contains. *Bracteæ*, one on the outside of each flower, ovate, convex internally, and somewhat cucullate, broadest on the outside of the capitulum, and there longer than the calyx, shorter than it in the centre. *Flowers* expand in succession from without inwards, generally only one or two at a time, standing three-fourths of an inch above the surface of the capitulum. *Calyx* ovate, acuminate, green, glabrous, shining, segments overlapping, greatly dilated upon one side, which is scariose, transparent, and passes between the next segment and the corolla (10½ lines long). *Corolla* (1 inch 4½ lines long) 3-parted, segments subequal, unguiculate, claws white, linear, glabrous, equal in length to the calyx (2¼ lines broad) erect, bearing on their inside at the base large, connate, smooth, shining, colourless, nectariferous glands; limb spreading, segments ovate, acuminate, blue, slightly striated in the centre, and paler behind and towards the edges. *Stamens* inserted at unequal heights into the claws, 3 into one, 2 into another, and 1 into the third; filaments flattened, similar in structure and colour to the claws of the corolla, inserted into the back of the anthers, and continued along these to their apices; anthers projecting into the throat of the corolla, of equal length and approximating at their apices (nearly 3 lines long), white, acuminate, cleft from the base for about a quarter of their length, above which they are connate along the back with the filaments; pollen white. *Pistil* equal in height to the stamens; stigmata 3, flattened, ciliated on one edge, spirally twisted; styles 3, united throughout their whole length; germen inferior, glabrous, 3-celled; ovulæ very numerous, small, attached to a central receptacle.

This plant was brought by Captain Graham of H. M. Packet Service from Mr Harris at Rio de Janeiro in 1824, and has grown freely in rich soil in the stove, pushing up three crowns from its root, only one of which has yet flowered.

## Erigeron humile.

E. *humile;* caule brevissimo unifloro: foliis integerrimis, ciliatis, sursum pubescentibus, patulis; radicalibus spathulatis basi longe attenuatis; caulinis lineare-lanceolatis acuminatis.

Description.—*Stem* nearly awanting, the whole plant, including the erect flower, not amounting to an inch in height. *Leaves* crowded, spreading, strongly ciliated, and sprinkled with a few simple colourless hairs on their upper surface, which is flat, dark green, channelled in the centre, veinless; behind they are slightly concave, rather lighter coloured, glabrous, and have a strong rib in the middle, and one on each side, distinct, though less strong, and scarcely branched; the lower leaves are obovato-spathulate, attenuated into petioles about as long as themselves, (together 7½ lines); those above are more spathulate, and the uppermost linear-lanceolate acuminate, all of them are quite entire in the edge. *Peduncle* terminal, short (about 1½ line), but longer than the stem, one-flowered. *Calyx* erect, campanulate (4½ lines long), provided with a 5-phyllous, lax, subulato-filiform calycle; scales subimbricated, unequal lanceolato-linear, their outside, as well as the outside of the calycle and the peduncle, thickly covered with long spreading purple hairs, naked and green on the inside, scarcely longer than the calycle. *Receptacle* rough. *Florets of the ray* equal to the length of the calyx, erect, linear, 2-toothed, concave, white; *those of the disk* less than half their length, yellow, 4-toothed, teeth blunt, suberect. *Filaments* inserted about the middle of the corolla, colourless. *Anthers* yellow, included. *Style* exserted. *Stigma* cleft; in the disk, segments yellow, pubescent, clavate and connivent; in the ray straighter, more cylindrical, paler and more smooth. *Germen* obconical, somewhat hairy. *Pappus* unequal, rough, as long as the florets of the disk.

The plants were raised from seed presented to the Royal Botanic Garden by Dr Richardson, on his return from the arctic shores of America in 1827. They flowered in September and October.

## Frankenia pauciflora.

F. *pauciflora;* foliis linearibus, obtusis, margine revolutis, ramulisque et calycibus acutis canescentibus; petiolis ciliatis; caulibus erectiusculis; floribus terminalibus, solitariis.

Frankenia pauciflora, *De Cand.* Prodr. i. 350. ?

Description.—*Stem* shrubby (1 foot high), suberect, branching. *Branches* diffused, opposite, twigs slender, round, scabrous, dichotomous. *Leaves* (½ inch long) green, scabrous, hoary or minutely tomentose, especially below, where paler, opposite, linear, blunt, slightly channelled at the base, reflected in the edges, middle rib prominent below. *Petiole* very short, adpressed, ciliated. *Flowers* (7½ lines long) solitary, terminal or in the cleft of the twigs, sessile. *Calyx* adpressed, scabrous, having also a minute tomentum as on the leaves, and in a slighter degree on the twigs, rigid, 5-toothed, 5-gonous, channelled, persisting, teeth acute, erect. *Corolla* 5-petaled, funnel-shaped; claws linear, as long as the calyx, yellowish; laminæ obovate, scarcely as long as the claws, sharply crenated at the apex, pale rose-coloured. *Stamens* six, unequal, subexserted; filaments white, flattened; anthers large, incumbent. *Germen* small, green, ovate, glabrous, unilocular, 3-valvular. *Style* filiform, 3-cleft. *Ovules* elliptical, attached to the edges of the valves.

This plant a native of New Holland, but I am not informed of what district, was obligingly communicated to us in spring last from Kew, under the name of *Frankenia pauciflora.* The decidedly scabrous leaves, branches, and calyx, may excite some doubt whether it be the plant to which De Candolle gives that name; but of this I know nothing, except from the short character in his Prodromus. Our specimen has been kept in the greenhouse.

## Mentha verticillata.

M. *verticillata;* spicis terminalibus, cylindricis, crassis, floribus densissime congestis; filamentis exsertis, pilis articulatis medio cinctis; caule ramoso ascendenti, basi repente; foliis verticillatis, superne quaternis, elliptico-linearibus, serratis.

Mentha verticillata, *Don,* Flor. Nepal. p. 114.—" *Roxb.* Hort. Bengal. p. 44.

" Mentha veronicæfolia, *Hamilton,* MS.

" Nepeta bracteata, ibid." fid. Don.

Mentha? pumila, *nob.* Edin. New Phil. Journ. for April 1828.

Description.—Annual. *Stem* cæspitose, ascending, rooting at the joints where it lies upon the ground, much branched, 6–8 inches high, striated, translucent, obscurely angled, the cells of the circumference large, empty, pale green, and equal in length to the joints, their walls being composed of a single row of small four-sided cells; those in the centre much smaller, succulent, surrounded by a purple membrane, to the angles of which the roots branches and leaves may be easily traced, and on the inside of which there is a fasciculus of spiral vessels. *Branches* simple. *Leaves* (1½ inch long) gradually smaller upwards, very numerous, verticelled, 4 in the whorls towards the top of the stem, often 5 or 6 below, (10, according to Don,) oblongo-linear, sparingly and distantly serrated in the upper half, rarely more than two serratures on each side, spreading, veinless, flat, slightly channelled above, keeled below, and having minute dots on both sides. *Inflorescence* a terminal, dense, whorled, cylindrical spike (on the leading shoot ⅘ths of an inch long, on the others shorter), much thicker than the top of the stem. *Bracteæ* one at the base of each flower, ovato-lanceolate, hairy and strongly ciliated, concave, connivent at the points, and as long as the calyx. *Calyx* ovate, inflated, 4-cleft, segments equal, connivent, pointed, hairy. *Corolla* 4-toothed, slightly spreading, hairy on the outside, twice the length of the calyx, nearly regular, purple, and varying with the internal membrane of the stem in the depth of its shade, lower segments slightly emarginate. *Stamens* 4, exserted; anthers like rounded, clavate terminations to the filaments, pale, unilocular, bursting in a line across their extremities, and becoming brown; pollen subglobular, white; filaments pink, straight, distant, having in their middle a whorl of hairs, appearing under the microscope like strings of round beads. *Style* filiform, as long as the stamens, cleft at the top; segments revolute. *Stigmata* capitate. *Germen* 4-lobed.

In a former number of this Journal, I described some very imperfect specimens of this species which flowered in December 1827, under the name of *Mentha? pumila.* More attention having been paid to its cultivation this season, it flowered in the stove two months earlier, and has attained a much greater size, confirming the suspicion formerly expressed by my acute friend Dr Hooker, that it might be the *M. verticillata* of Don's Flora Nepalensis. I can rest this on the authority of Mr Don himself, who compared a specimen which I sent to him with some gathered by Dr Hamilton. He writes that they " precisely agree." The plant, however, appears to vary exceedingly; for Dr Hamilton, to whom I also sent a specimen, informs me that " they have very little general resemblance" to the native specimens of *M. verticillata* in his possession, these being much larger, and having spikes as long as the whole of my plant. Still, however, he has " some doubt of their being different," and ascribes the smaller size of our plant to their having been raised in pots set in a flat of water, but not submersed, while in its native situation it grows " in rice fields, or by the sides of ditches or ponds, with the lower part of the stems under water."

The greater part of our specimens have damped off, and I do not expect that any will live to produce seed.

I am not more satisfied than before with the generic name of this species. The structure and properties seem to require that a new genus should be constituted, to contain this and many others, native of India; and probably the structure of the anther will materially assist in furnishing a character.

## Persoonia pallida.

P. *pallida;* foliis filiformibus, canaliculatis, mucronatis, æqualibus; floribus congestis; pedunculis axillaribus, solitariis, rectis, unifloris; perianthiis subglabris; stylis ovario monospermo longioribus, rectis.

Description.—*Shrub* erect. *Stem* (in our specimen 3 feet high) flexuose, round, brown. *Branches* verticelled, ascending, yellowish-green, leafy, nearly devoid of pubescence. *Leaves* (1 inch long) all alike, linear, almost filiform, but flattened and slightly channelled above, mucronate, at the base somewhat attenuated, and adpressed for a little way, at first suberect, afterwards spreading, sparingly ciliated when young, subsequently nearly naked, minutely warted, light green. *Flowers* collected in clusters, which surround the branches near their extremities, yellow, shorter than the leaves. *Peduncles* very short, axillary, solitary, straight, nearly glabrous, except at the base of the perianth, where there are a few spreading hairs. *Perianth* tetraphyllous, before expanding (4½ lines long) orange coloured, contracted above the germen, from which, upward, it is cylindrical, and crowned with four diverging awl-shaped points; afterwards more yellow and paler, revolute in its upper half, each segment terminated by a mucro projecting obliquely from its posterior surface. *Glands* 4, obovate, erect, small, rising from the receptacle within the perianth, persisting, becoming brown. *Stamens* 4; filaments arising from the base of the perianth, and united to it over their whole length; anthers free, longer than the filaments, blunt, linear, arising from below the middle of the perianth, erect, and applied to the style, towards their apices revolute, bilocular, loculaments bursting along the front, and each with a longitudinal imperfect septum; pollen granules shining, angular. *Pistil* straight, rather longer than the stamens, equal to the perianth exclusive of the mucro; stigma, terminal, oblique, concave, slightly gibbous on its lower side; style straight, or slightly flexuose, tapering, smooth; germen on a short footstalk, smooth, gibbous, many times shorter than the style, evalvular, fleshy, monospermous. The whole plant, the pollen only excepted, becomes brown in drying.

This species must stand next to *P. pinifolia*, which, however, is at once distinguished by its lurid colour, its much greater degree of pubescence, by there being no portion of the leaves at the base adpressed, by these neither being flattened nor channelled, and by the floral leaves being shorter than the others. Our plant was raised from seed sent to my friend Captain Wauch from New South Wales, and by him obligingly communicated to the Botanic Garden in 1824. It has received in the greenhouse the ordinary treatment of New Holland plants, and flowered very freely in September and October last.

## *Celestial Phenomena from January* 1. *to April* 1. 1829, *calculated for the Meridian of Edinburgh, Mean Time.* By Mr George Innes, Aberdeen.

The times are inserted according to the Civil reckoning, the day beginning at midnight. —The Conjunctions of the Moon with the Stars are given in *Right Ascension.*

### JANUARY.

| D. | H. | ′ | ″ | |
|---|---|---|---|---|
| 1. | 20 | 8 | 36 | ☌ ☿ λ ♐ |
| 1. | 23 | 12 | 56 | ☌ ☽ 4 ζ ♎ |
| 1. | 23 | 40 | 58 | ☌ ☽ γ ♎ |
| 2. | 7 | 56 | 19 | ☌ ☽ ϑ ♎ |
| 2. | 21 | 2 | 30 | ☌ ☽ ♃ |
| 2. | 23 | 24 | 0 | ☌ ☽ φ Oph. |
| 3. | 4 | 10 | 0 | ☌ ☽ ♀ |
| 5. | 3 | 40 | 16 | ☌ ☽ ☿ |
| 5. | 15 | 45 | 36 | ● New Moon. |
| 6. | 18 | 11 | 23 | ☌ ☽ β ♑ |
| 6. | 20 | 29 | 37 | ☌ ☽ ♅ |
| 8. | 17 | 6 | 38 | ☌ ☽ ϑ ♒ |
| 10. | 6 | 1 | 0 | Im. II. sat. ♃ |
| 10. | 17 | 11 | 25 | ☌ ☽ ♂ |
| 10. | 19 | 22 | 54 | ☌ ♀ φ Oph. |
| 11. | 23 | 23 | 11 | ☌ ☽ ζ ♓ |
| 12. | 7 | 14 | 10 | ☽ First Quarter. |
| 12. | 13 | 22 | 29 | ☌ ☽ ο ♓ |
| 14. | 5 | 12 | – | Sup. ☌ ☉ ♀ |
| 15. | 13 | 0 | 29 | ☌ ☽ 1 δ ♉ |
| 15. | 13 | 30 | 22 | ☌ ☽ 2 δ ♉ |
| 19. | 3 | 44 | 18 | ☌ ☿ ♅ |
| 20. | 0 | 15 | 42 | ○ Full Moon. |
| 20. | 2 | 27 | 14 | ☌ ☽ ♄ |
| 20. | 5 | 24 | 24 | Em. II. sat. ♃ |
| 20. | 5 | 42 | 19 | ☉ enters ♒ |
| 20. | 23 | 10 | 19 | ☌ ☽ 2 α ♋ |
| 21. | 2 | 45 | – | ☍ ☉ ♄ |
| 21. | 15 | 27 | 34 | ☌ ☽ ξ ♌ |
| 21. | 20 | 37 | 58 | ☌ ☽ ο ♌ |
| 22. | 6 | 49 | 20 | ☌ ☽ π ♌ |
| 22. | 1 | 15 | – | ☌ ☉ ♅ |
| 27. | 17 | 57 | 58 | ☌ ☽ κ ♍ |
| 28. | 4 | 10 | 8 | ☌ ♀ σ ♐ |
| 28. | 5 | 21 | 41 | ☾ Last Quarter. |
| 29. | 5 | 59 | 18 | Im. I. sat. ♃ |
| 29. | 8 | 54 | 3 | ☌ ☽ γ ♎ |
| 29. | 17 | 25 | 1 | ☌ ☽ ϑ ♎ |
| 30. | 4 | 9 | 26 | ☌ ♀ ο ♐ |
| 30. | 9 | 20 | 7 | ☌ ☽ φ Oph. |
| 30. | 17 | 5 | 47 | ☌ ☽ ♃ |

### FEBRUARY.

| D. | H. | ′ | ″ | |
|---|---|---|---|---|
| 1. | 18 | 4 | 16 | ☌ ☽ ε ♓ |
| 2. | 4 | 43 | 55 | ☌ ☽ ♀ |
| 3. | 5 | 21 | 10 | ☌ ☽ β ♑ |
| 3. | 7 | 55 | 26 | ☌ ☽ ♅ |
| 4. | 2 | 32 | 13 | ● New Moon. |
| 5. | 3 | 22 | 22 | ☌ ☽ ϑ ♒ |
| 5. | 4 | 26 | 54 | ☌ ☽ ☿ |
| 5. | 21 | 56 | 14 | ☌ ♂ ζ ♓ |
| 8. | 6 | 53 | 4 | ☌ ☽ ζ ♓ |
| 8. | 10 | 13 | 56 | ☌ ☽ ♂ |
| 8. | 20 | 24 | 58 | ☌ ☽ ο ♓ |
| 10. | 16 | 10 | 52 | ☌ ☿ λ ♒ |
| 10. | 19 | 24 | 27 | ☽ First Quarter. |
| 11. | 5 | 33 | 57 | Im. II. sat. ♃ |
| 11. | 18 | 39 | 0 | ☌ ☽ 1 δ ♉ |
| 11. | 19 | 8 | 39 | ☌ ☽ 2 δ ♉ |
| 12. | 0 | 13 | 58 | ☌ ☽ α ♉ |
| 13. | | | | ☿ greatest elong. |
| 14. | 4 | 14 | 31 | Im. I. sat. ♃ |
| 16. | 4 | 30 | 9 | ☌ ☽ ♄ |
| 16. | 6 | 46 | – | ☌ ♀ ♅ |
| 17. | 4 | 15 | 28 | ☌ ☽ 1 α ♋ |
| 17. | 5 | 22 | 37 | ☌ ☽ 2 α ♋ |
| 17. | 21 | 43 | 30 | ☌ ☽ ξ ♌ |
| 18. | 2 | 54 | 10 | ☌ ☽ ο ♌ |
| 18. | 13 | 5 | 35 | ☌ ☽ π ♌ |
| 18. | 19 | 16 | 59 | ○ Full Moon. |
| 18. | 20 | 26 | 0 | ☉ enters ♓ |
| 20. | 10 | 24 | 22 | ☌ ☽ π ♌ |
| 22. | 10 | 35 | 37 | ♀ near ϑ ♑ |
| 22. | 16 | 16 | 26 | ☌ ☽ ϑ ♍ |
| 24. | 0 | 23 | 9 | ☌ ☽ κ ♍ |
| 25. | 16 | 3 | 57 | ☌ ☽ γ ♎ |
| 26. | 0 | 48 | 32 | ☌ ☽ ϑ ♎ |
| 26. | 17 | 12 | 17 | ☌ ☽ φ Oph. |
| 26. | 20 | 20 | 55 | ☾ Last Quarter. |
| 27. | 6 | 27 | 23 | ☌ ☽ ♃ |
| 28. | 15 | 15 | – | Inf. ☌ ☉ ☿ |

### MARCH.

| D. | H. | ′ | ″ | |
|---|---|---|---|---|
| 2. | 16 | 14 | 46 | ☌ ☽ β ♑ |
| 2. | 20 | 28 | 30 | ☌ ☽ ♅ |
| 4. | 1 | 10 | 20 | ☌ ☽ ♀ |
| 4. | 2 | 55 | 15 | Im. III. sat. ♃ |
| 4. | 5 | 13 | 11 | Em. III. sat. ♃ |
| 4. | 14 | 48 | 16 | ☌ ☽ ϑ ♒ |
| 4. | 22 | 3 | – | ☌ ☽ ☿ |
| 5. | 12 | 35 | 13 | ● New Moon. |
| 7. | 16 | 54 | 47 | ☌ ☽ ζ ♓ |
| 8. | 4 | 56 | 12 | Em. II. sat. ♃ |
| 8. | 5 | 59 | 53 | ☌ ☽ ο ♓ |
| 9. | 4 | 23 | 4 | Im. I. sat. ♃ |
| 9. | 5 | 42 | 0 | ☌ ☽ ♂ |
| 11. | 1 | 56 | 16 | ☌ ☽ 1 δ ♉ |
| 11. | 2 | 25 | 8 | ☌ ☽ 2 δ ♉ |
| 11. | 7 | 23 | 30 | ☌ ☽ α ♉ |
| 12. | 9 | 46 | 1 | ☽ First Quarter. |
| 15. | 5 | 3 | 55 | Im. II. sat. ♃ |
| 15. | 8 | 38 | 18 | ☌ ☽ ♄ |
| 16. | 10 | 22 | 31 | ☌ ☽ 1 α ♋ |
| 16. | 11 | 30 | 0 | ☌ ☽ 2 α ♋ |
| 17. | 3 | 54 | 7 | ☌ ☽ ξ ♌ |
| 17. | 9 | 5 | 27 | ☌ ☽ ο ♌ |
| 17. | 19 | 18 | 9 | ☌ ☽ π ♌ |
| 19. | 16 | 36 | 18 | ☌ ♀ τ ♌ |
| 20. | 13 | 45 | 50 | ○ Full Moon. |
| 20. | 20 | 31 | 27 | ☉ enters ♈ |
| 21. | 4 | 34 | – | ☌ ♀ φ ♒ |
| 21. | 22 | 11 | 1 | ☌ ☽ ϑ ♍ |
| 23. | 6 | 6 | 54 | ☌ ☽ κ ♍ |
| 24. | 21 | 47 | 34 | ☌ ☽ γ ♎ |
| 25. | 2 | 38 | 25 | Im. I. sat. ♃ |
| 25. | 6 | 35 | 30 | ☌ ☽ ϑ ♎ |
| 25. | 23 | 9 | 45 | ☌ ☽ φ Oph. |
| 26. | 15 | 32 | 42 | ☌ ☽ ♃ |
| 27. | . | . | . | ☿ greatest elong. |
| 28. | 7 | 11 | 45 | ☾ Last Quarter. |
| 30. | 12 | 53 | 33 | ☌ ☽ ϑ ♒ |

## *Times of the Planets passing the Meridian.*

### JANUARY.

| | Mercury. | | Venus. | | Mars. | | Jupiter. | | Saturn. | | Georgian. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D. | H. | ′ | H. | ′ | H. | ′ | H. | ′ | H. | ′ | H. | ′ |
| 1 | 11 | 31 | 9 | 38 | 16 | 50 | 9 | 28 | 1 | 38 | 13 | 30 |
| 5 | 11 | 44 | 9 | 43 | 16 | 45 | 9 | 16 | 1 | 21 | 13 | 16 |
| 10 | 11 | 59 | 9 | 50 | 16 | 38 | 9 | 1 | 1 | 0 | 12 | 59 |
| 15 | 12 | 16 | 9 | 56 | 16 | 31 | 8 | 45 | 0 | 38 | 12 | 39 |
| 20 | 12 | 30 | 10 | 3 | 16 | 23 | 8 | 29 | 0 | 16 | 12 | 20 |
| 25 | 12 | 46 | 10 | 10 | 16 | 16 | 8 | 12 | 23 | 50 | 12 | 1 |

### FEBRUARY.

| | Mercury. | | Venus. | | Mars. | | Jupiter. | | Saturn. | | Georgian. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D. | H. | ′ | H. | ′ | H. | ′ | H. | ′ | H. | ′ | H. | ′ |
| 1 | 13 | 7 | 10 | 21 | 16 | 8 | 7 | 50 | 23 | 21 | 11 | 35 |
| 5 | 13 | 14 | 10 | 26 | 16 | 3 | 7 | 36 | 23 | 8 | 11 | 21 |
| 10 | 13 | 22 | 10 | 34 | 15 | 56 | 7 | 20 | 22 | 45 | 11 | 3 |
| 15 | 13 | 17 | 10 | 40 | 15 | 48 | 7 | 3 | 22 | 22 | 10 | 44 |
| 20 | 13 | 1 | 10 | 46 | 15 | 42 | 6 | 46 | 22 | 1 | 10 | 25 |
| 25 | 12 | 30 | 10 | 51 | 15 | 35 | 6 | 28 | 21 | 40 | 10 | 6 |

### MARCH.

| | Mercury. | | Venus. | | Mars. | | Jupiter. | | Saturn. | | Georgian. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D. | H. | ′ | H. | ′ | H. | ′ | H. | ′ | H. | ′ | H. | ′ |
| 1 | 12 | 1 | 10 | 56 | 15 | 31 | 6 | 14 | 21 | 24 | 9 | 53 |
| 5 | 11 | 32 | 10 | 59 | 15 | 25 | 6 | 1 | 21 | 8 | 9 | 38 |
| 10 | 11 | 3 | 11 | 4 | 15 | 19 | 5 | 43 | 20 | 48 | 9 | 19 |
| 15 | 10 | 42 | 11 | 8 | 15 | 12 | 5 | 24 | 20 | 26 | 9 | 0 |
| 20 | 10 | 31 | 11 | 12 | 15 | 7 | 5 | 6 | 20 | 15 | 8 | 41 |
| 25 | 10 | 26 | 11 | 15 | 15 | 0 | 4 | 47 | 19 | 46 | 8 | 22 |

# PROCEEDINGS OF LEARNED SOCIETIES.

## 1. *Royal Society of Edinburgh.*

The first meeting of the Royal Society of Edinburgh, for the session 1828–9, took place on Monday 1st December, when there were read "Observations on Topographical Modelling and Delineation. By W. Bald, Esq. M. R. S. A. &c."

## 2. *Wernerian Natural History Society.*

1828, *Nov.* 15.—The Society met for the session; Robert Stevenson, Esq. formerly V. P. in the chair.

Professor Jameson read a notice regarding the colossal Tusks of the Fossil Elephant, found in an iceberg on the shores of the Arctic coast of America by Captain Beechy; and the tusks themselves were exhibited, having lately been presented to the Museum of the University, by Lord Melville.

There was also read a communication from Mr Blackader, regarding the junction and mode of formation of the Basalt of the Castle Rock of Edinburgh, and the neighbouring strata, as illustrated by the appearances at present displayed in the new cuts and openings of the strata, in the course of forming the Western Approach.

*Nov.* 29.—Henry Witham, Esq. V. P. in the chair.

The Reverend Dr David Scot of Corstorphine, read a paper on the Nimur of the ancient Hebrews, translated Leopard; and on the Sis or Swallow of the Hebrew writings, erroneously translated Crane in the English Bible.

Specimens of the Grizzly Bear,—of an animal intermediate between the sheep and the antelope,—and also of the new species of wolf, fox, and badger, collected by Captain Franklin and Dr Richardson, during the late expedition to the Arctic countries of North America, were exhibited to the meeting, and were described by Professor Jameson.

At this meeting, the following gentlemen were elected office-bearers of the Society for 1829:—

*President.*

Robert Jameson, Esq.

*Vice Presidents.*

Dr Robert Knox.
G. A. W. Arnott, Esq.
Henry Witham, Esq.
Dr Walter Adam.

*Secretary*, Pat. Neill, Esq.
*Treasurer*, A. G. Ellis, Esq.
*Librarian*, James Wilson, Esq.
*Assistant*, Mr W. Macgillivray.
*Painter*, P. Syme, Esq.

*Council.*

E. W. A. Drummond Hay, Esq.
Dr Andrew Coventry.
Dr John Boggie.
Rev. Dr Brunton.
John Stark, Esq.
Dr John Aitken.
Sir Arthur Nicolson, Bart.
Dr John Gillies.

At the same meeting, Thomas Jameson Torrie, Esq. and Alexander Turnbull Christie, M. D., were elected Resident Members of the Society.

### 3. *Linnean Society.*

Nov. 4. 1828.—Mr Bicheno read a paper on the advantages attending the use of the English language in Natural History.

The author insists, that the use of Latin and other foreign languages, in the classification of natural history, has retarded its progress; and that an acquaintance with the productions of nature was more extensively diffused before the Latin became the vehicle of communication. Gerard has recorded some thousands of English names of plants, derived from an English stock, which are no longer in use; while every indigenous species known to our ancestors, seems to have had a familiar name in English, Welsh and Erse. Ask a farmer now, how many plants he is acquainted with; and he will betray an incredibly scanty stock of knowledge, for one who is traversing the carpet of the earth many hours of every day of his life; he will confound under the name of Charlock more than half a dozen species; and out of a hundred kinds of grass, he will be acquainted with a most insignificant number.

Professor Michaelis remarks, that the eastern nations must have been better acquainted with the vegetable kingdom than ourselves; since we find more than 250 plants named in the Old Testament, by writers who have made use of their names, in prose and metre, only incidentally, and not as botanists; and that, in all probability, such knowledge must, in those times, have been very generally diffused.

Of all sciences, natural history is one of observation. To lock it up, therefore, in a dead language, or to give it less currency among the rural part of the population, whose business is with the operations of nature, is to confine it within the bounds of the closet. For the want of names, the attention of the English scholar is not arrested, or he has no means of recording his observations; and the learned, pent up in cities, or only making an occasional excursion out of them, turn their more copious vocabulary to less account, and their faculty of observation to such trifling and minute particulars as their studies will afford.

The great storehouse of botanical and zoological names is still to be found in the writings of the Greeks. Among them learning and science, philosophy and poetry, went hand in hand. The people were taught every thing; natural history was diffused; and they have handed down, for our use, a stock of names which no other language can equal.

It may, perhaps, remain doubtful, whether the old English names are not too much forgotten to be revived; and whether it is not now, in many cases, as easy to establish the foreign names. Still there would remain much that might be familiarised to the English scholar, by the use of his native language.

Among living languages, ours is admirably adapted for the teaching of sciences, in which new terms are requisite. Foreign words are easily engrafted or transplanted into it. It allows of a great variety of compounds and diminutives, and those terminating either as substantives, adjectives, verbs or participles, both active and passive. It has been asserted by competent judges, that it is in these respects as accommodating as the Latin, and not much less so than the Greek. To the honour of the late President of the Linnean Society, he did much to familiarize the recondite language of botany to the English student. The probability is, that naturalists will very soon be forced to adopt their native language as a vehicle of communication. Our popular schools, universities, gardens and publications, all tend this way.

Such an occurrence need not prevent the learned of all nations from still holding intercourse; and it would throw open to multitudes a boundless field of experiment and observation. Wherever a learned language has been in the possession of a privileged class, history and experience shew that the excluded party is left in ignorance; and the establishment of a "universal character," so much desired by some of the philosophers of the 17th century, instead of advancing knowledge, as they imagined, would most materially have retarded it, and have kept the people in darkness.

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## SCIENTIFIC INTELLIGENCE.

### NATURAL PHILOSOPHY.

1. *On the Electrical Phenomena caused by the Rubbing of Metals with each other.*—M. Becquerel, on 3d June 1828, read to the Academy of Sciences of Paris, a *memoir on the electrical phenomena which result from the rubbing of metals with each other.* —Natural philosophers have hitherto confined themselves to the study of the electrical effects resulting from the mutual friction of bodies which are bad conductors of electricity, together with the friction of these with metals. M. Becquerel wished to see what result would take place when metals were rubbed together. The author, by means of the galvanometer, was enabled to arrange the metals, according to their electrical properties, by friction, in the following order: bismuth, nickel, cobalt, palladium, platina, lead, tin, gold, silver, copper, zinc, iron, cadmium, antimony. This order, in which each metal is positive with relation to those which precede, and negative with relation to those which follow it, is precisely the same as that of the electrical effects, which are developed in a circuit formed of two metallic wires soldered end to end, and in which the temperature of one of the solderings is raised, while that of the other remains uniform. Now, as friction developes heat, it might be imagined that here also it is it that gives rise to thermo-electric effects; but M. Becquerel has proved that this is not the case. In place of gently rubbing the two bodies, he pressed them strongly against each other, or struck them with repeated blows. These two actions develope heat more than a slight rubbing does, and yet there is no manifestation of electrical effects. To produce these, it is therefore necessary to impress a particular

mode of shaking upon the molecules in the direction of the surface, which would seem to render it probable that these phenomena arise from a vibratory motion transmitted by these molecules. The second method which M. Becquerel employed for observing the electrical effects of friction in metals, was invented by M. Singer; but M. Becquerel effected important modifications in it, without which he could not have made the observations which he detailed in his memoir. This process consists in taking a plate of metal, which is kept inclined while metallic filings are thrown upon it, which are received in a metal capsule, communicating with a very delicate electroscope. The filings, in their passage over the plate, acquire an electricity, which is owing to the friction, and not to an act of contact, as M. Becquerel proved in a direct manner. The filings of a metal are negative with relation to a plate of the same metal. Zinc filings are positive with gold, platina, silver, iron, bismuth, and lead, while they are negative with tin, antimony, and cadmium. In general, metallic filings, when they fall upon a plate of metal, have a tendency to assume the negative electricity. This tendency, however, does not prevent the filings of a positive metal from being positive with relation to the more negative metals.

2. *On the Variation of the Freezing Point in Mercurial and Spirt of Wine Thermometers;* by M. Yelin.—M. Bellani appears to be the first who discovered, in 1808, that the freezing point is liable to vary. He mentioned it in the Pavia Journal of Natural Philosophy; but his observation did not attract the attention of philosophers, and was forgotten, until the editors of the Bibliotheque Universelle took the subject in hand. Of twenty-one thermometers which M. Yelin submitted to a new examination, there was only one that retained its original freezing point. In most cases the freezing point was too high, so as to correspond sometimes to + 2°. Cases, however, were met with in which it was too low.—*Kastner's Archiv*, t. ii. p. 109.

### METEOROLOGY.

3. *On the Weight of pure Atmospheric Air.*—Dr Prout is at present occupied with the investigation of this important subject; and though he has not yet brought his researches to a conclusion, he permits me to state, that 100 cubic inches of pure

atmospheric air, at 60° Fahr., and 30 inches of the barometer, weigh at least 31 grains. The estimate of 30.5 grains, deduced from the observations of Schuckburgh, is therefore incorrect.—*Turner's Chemistry*, p. 808.

## CHEMISTRY.

4. *On Efflorescence.*—The following observations are by M. Gay Lussac. Many salts, when exposed to the air, are well known to effloresce; that is, they fall to powder, and lose their water of crystallization; and it is generally supposed that salts, after efflorescence, are perfectly anhydrous. Having been long convinced that this opinion is not correct, I have made some experiments upon the principal salts, which are efflorescent in a high degree. Crystallised sulphate of soda, exposed to the air, even when it is not very dry, readily loses all its water of crystallization. Phosphate of soda becomes readily opaque, without losing its form. After three months exposure to the air, it contained, on the 18th of July, 7.4 of the 12 proportions of water, which it contains in its usual state. Reduced to powder, and thinly spread upon paper, it contained, on the 26th of July, 5.65 proportions of water; again exposed to the air during a hot and dry period, it contained, on the 31st of July, only 5.65 proportions; afterwards exposed till the 21st of October, the weather having become colder and more damp, it was found to contain 7.2 proportions of water; some phosphate, which had been calcined, absorbed, in five days' exposure to the air, nearly half a proportion of water. Carbonate of soda, on exposure, exhibits nearly the same phenomena as the phosphate; it becomes opaque, loses much water without altering its form; but I have never found it anhydrous after exposure. It results from these observations, that some salts completely lose their water of crystallization by efflorescence; but that others retain variable quantities, according to the hygrometric state of the air. I do not assert, however, that the water may not remain in definite proportions; it merely appears that, in the phosphate and carbonate of soda, which retains a proportion of water of a certain number,—the seventh for example,—differs but little from that which unites the proportion immediately above or below.—*Ann. de Chem.* xxxvi. 335.

## MINERALOGY.

5. *Okenite, a New Species of Zeolite.*—Colours yellowish and bluish white. Lustre glimmering, glistening, and pearly. Fibrous, sometimes passing into compact. Hardness, between that of felspar and fluorspar. Specific gravity = 2.28 at 16° R. *Constituent parts.*—Silica 55.64; lime 26.59; water, with trace of ammonia, 17.00; alumina with trace of iron, 0.53 = 99.76. The essential constituent parts are then silica, lime and water, which may be expressed by the following formula:

$$C^{\ddot{3}}\ S^{\dddot{8}} + 12 \text{ aq.};\ \text{or } C\ 8^{4} + 2 \text{ aq.}$$

If we estimate the constituents according to this formula, there results,

| | | | | |
|---|---|---|---|---|
| Silica, | 56.99 | Oxygen, | 29.6 | 4 |
| Lime, | 26.85 | ... | 7.4 | 1 |
| Water, | 16.25 | ... | 14.8 | 2 |
| | 99.99 | | | |

It was brought from Disco Island, in Greenland, and named by Kobell in honour of Oken, the well known naturalist.

6. *On the Compact Garnet of Schwarzenstein or Zillerthal, in the Tyrol.* By Von Kobell.—Garnet generally occurs either in regular crystals or in granular concretions; seldom in a compact form. A garnet of the latter description occurs at Schwarzenstein. Colour greyish and yellowish-white, which, in some places, passes into pale green. Lustre resinous. Fracture uneven, imperfect conchoidal, or splintery. Translucent on the edges. Specific gravity = 3.86 at 15½° R. Melts easily and quietly before the blowpipe, and agrees with calcareous garnet in its relation to fluxes, and in the humid way. Constituent parts are as follows:

| | | | |
|---|---|---|---|
| Silica, | 41.00 | Oxygen, | 21.31 |
| Alumina, | 17.96 | ... | 8.26 |
| Oxide of Iron | 4.50 | ... | 1.57 |
| Lime, | 33.00 | ... | 9.26 |
| Magnesia, | 2.59 | ... | 1.00 |
| Oxide of Tin, | 0.30 | | |
| | 99.35 | | |

The formula for this species will be $\left.\begin{matrix}A\\F\end{matrix}\right\} S + \left.\begin{matrix}C\\M\end{matrix}\right\} S.$

The agreement in physical properties and chemical composition of this garnet, with a mineral analyzed some years ago by Kobell, under the name *Compact Vesuvian*, is worthy of remark. The analysis is as follows:

| | | | |
|---|---|---|---|
| Silica, . . . | 41.55 | Lime, . . | 32.70 |
| Alumina, . . . | 17.60 | Trace of Magnesia. | |
| Oxide of Iron, . . | 5.20 | | |
| | | | = 97.05 |

This mineral, a native of the Tyrol, is principally distinguished from the garnet of Schwarzenstein by its intumescing before the blowpipe, while the garnet melts without intumescence. But this property of intumescence occurs in every variety of Vesuvian, while a tranquil melting characterizes the garnets. The cause of this difference, and also that of the difference in crystallization, in two minerals which have the same chemical composition, has not been ascertained.

7. *New Species of Brittle Silver-Glance.* — Professor G. Rose is at present occupied with the analysis of the different minerals known under the name Brittle Silver-glance (*Spröd glaserz*), and has already detected among them several new and distinct species. His brother, Professor H. Rose, is analysing the tetrahedral copper-glance, and those minerals which contain sulphuret of antimony and sulphuret of arsenic.

8. *Fluor-spar found in Ben-Gloe in Perthshire.*—Mr James Macinroy Duff, last summer, found, at the foot of Ben-Gloe, on the east side of Glen-Tilt, specimens of cubical pale red coloured fluor-spar.

## GEOLOGY.

9. *Humboldt's Journey to Siberia.*—Humboldt, although now past his sixtieth year, leaves Germany next spring, accompanied by Professor G. Rose, for Siberia. Probably he will extend his researches to the high land which separates India from the Russian Empire.

10. *Meeting of Naturalists in Berlin.*—Some years ago, Oken, the celebrated naturalist, proposed that the naturalists of Germany should meet together once a year, with the view not only of becoming personally known to each other, but also of a mutual

communication of discoveries and opinions,—the planning of new experiments, new scientific expeditions, and new works, in natural history. The scheme, at first, was but coldly received, and the meetings but indifferently attended; of late, however, a great change of feeling, in regard to Oken's view, has taken place; and now we find collected together at these interesting meetings, many of the most distinguished writers and travellers. The meeting for this year took place last autumn at Berlin, and was of the most splendid description. Naturalists from all parts of Germany were present, and the interest of the scene was heightened by the appearance of Berzelius, and other distinguished philosophers from Scandinavia. Humboldt, who was conductor, gave, on one of the last days of the meeting, a splendid *assemblée* in the magnificent hall of the Royal Theatre, which was attended by all the naturalists and artists in Berlin, and honoured by the presence of the king, the different princes of his house, all the foreign princes at the time in Berlin, the ministers of state, generals, ambassadors, and strangers of distinction. The King of Prussia, although he very wisely refrains from encouraging the wild and visionary political views of some of the learned of his kingdom, not only honours science and literature, but encourages, in a munificent manner, those who devote themselves to their advancement.

## ZOOLOGY.

11. *New Method of Preserving Fishes.*—Whenever it is possible, the person intending to preserve fishes ought to catch them himself, or be present at their capture; for, in order to make them retain their colours, they must be killed in alcohol at 36°, in which they are to remain for six days; the precaution being always taken after their death of opening the belly without disturbing the intestines, and emptying the latter of their contents, which may be done by pressure. The manner in which the opening is made is not a matter of indifference. The fish should be placed on its back, the head towards the operator, who then commences his incision under the pectoral fins, and continues it obliquely to the left side of the tail. This opening, so made, affords more facility afterwards for sewing, when the skin of the fish is to be prepared. After these prepa-

ratory operations, and after the fishes have remained six days in the alcohol, the liquid is to be changed for alcohol at 18°, in which they are to remain other six days. Those of large size should then be placed on a board, and completely covered with salt for eight hours. They are then to be put in a dry place, exposed to the action of the sun through the day, and defended from moisture at night. After this they must be well wiped to remove all the salt, and bandaged with linen to prevent the scales from being rubbed. They are then to be put in alcohol at 18°, in which they should remain for transportation. The flesh is penetrated by the salt, and when they are in alcohol at 18°, which contains much water, this water seizes the salt, and forms an alcoholized brine, which keeps them perfectly fresh, with all their colours, many months, even in tropical climates, as M. Ricord observed during the voyage which he has lately made to the Island of Hayti. All these preparations must be made in different casks. The cask in which the fishes are to be put for transportation must be pitched on the outside, and well washed internally with chloride of lime, and afterwards with alcohol at 36°, to remove the chloride, which might alter the colour of the fishes. Parchment tickets written with ink, bearing the number corresponding to the name of each fish, are to be attached to the tail by means of a thread passed through it, that, on loosing the bandages, they may not be torn off. On arriving at their places of destination, the fishes are to be put in alcohol at 25°. This new method of preserving fishes is much more expensive than the old, but it is also more effectual.—Fishes whose skins only are to be sent home, must be skinned in a deep vessel filled with alcohol. In this way the scales do not come off. When the skins are prepared, silk-paper is stuck to them with mucilage, so as to cover them completely, which prevents the scales from being detached during the voyage. The paper will readily come off again at pleasure, by putting the skins a few minutes in water. The colour of the eye is to be painted on the paper which bears the number corresponding to the name, which is attached by means of a thread drawn through the head by the orbits.—*Bulletin Univers.*

12. *Sea Birds, &c. of the Isle of May.*—Mr Pithie, the intelligent light-keeper on the Isle of May, in a note to his Return to the

Engineer for the Northern Light-houses for October 1828, mentions, that "all the sea-birds have now (October 20.) left the island, except the scarts, (cormorants, *Phalacrocorax Carbo)*, which come in numbers to winter there. They roost on the shelves on the west side, and also on the outer rocks of the North Ness. Early in the spring, they all take their departure, except a few which remain over the summer, and hatch in the cover on the west side of the island. Small podleys (fry of coalfish, *Merlangus carbonarius*) are, at this season, in great numbers all around the island, close by the rock-foot. These podleys are now about three inches in length." Till nearly the end of the month, Fahrenheit's thermometer was daily about 50°. When the temperature fell lower than this, the mercury in the barometer rose very high; from the 27th to the 29th it ranged from 30° 29′ to 30° 44′; wind southerly. The weather was dry, the rain-gauge only giving 0.79 for the month.

13. *Changes in Animals.*—At one of the recent sittings of the Academy of Sciences at Paris, an interesting paper was read by M. Roulin, on the changes which the domestic animals of Europe undergo when transported to the equatorial regions of the New World. The author's observations are stated to have been made in New Grenada, and a part of Venezuela, from the 3d to the 10th degree of N. Lat. and from the 70th to the 80th degree of W. Long. He states, at the commencement of his paper, that the mammiferous animals brought from the Old to the New Continent, are pigs, sheep, goats, asses, horses, cows and dogs, all of which are become more numerous than the indigenous animals of the new countries. It appears that the hog, in the warm valleys of South America, wandering in the woods, and subsisting upon wild fruits, becomes very ferocious, and assumes almost the character of the wild boar. The first introduction of pigs into these climates, was in St Domingo, in 1493, one year after the discovery of America. They were successively introduced into all the places inhabited by Spaniards; and, in the space of half a century, they were to be found multiplying rapidly, from the 25th degree of N. Lat. to the 45th degree of S. Lat. The larger animals were also first introduced into St Domingo, where, for some years, they did not appear to thrive; but, by the persevering management of the colonists, they began to multiply

prodigiously, and great numbers were sent to Mexico. Such at length was the fertility of production in St Domingo, that, notwithstanding numerous exportations, herds of 4000 head of cattle were very common in that island, twenty-seven years after its discovery. Some herds are even stated to have numbered 8000; and, in 1587, the exportation of hides from St Domingo was 35,444: and, in the same year, 64,350 hides were exported from New Grenada. The principal treatment to ensure fecundity in these animals, was to pasture them in situations where the food possessed saline properties. In places where the quantity of salt, either in the water or plants, was small, they were found to deteriorate in quality, and to diminish in number. In these climates, the cow undergoes a material change. It no longer furnishes the constant supply of milk which we obtain from it by artificial means in Europe; and, in order to obtain that fluid at all, it is necessary that the calf should be continually with its mother. The milk obtained for domestic use, is only that which accumulates during the night when the calf is in a quiescent state; when the calf ceases to suck, the milk immediately dries up. The bulls and cows introduced from Europe into South America soon become wild; and, at the present time, it is only by repeated battues that they are kept in subjection. The ass undergoes, in the provinces which M. Roulin has visited, less change than any other animal. He never becomes wild but in situations where the labour is excessive. The propagation of the species is attended with several instances of deformity. It is very different with the horse. By the independent life which it leads, it almost resumes the character of the wild horse, and is remarkable for the great similarity of colour. A bright chestnut is the prevailing and nearly the only colour of the horses of South America. The favourite pace of these horses is the amble, which they are taught at a very early age. They do not remain fit for service many years, as they become liable to swellings, which are generally incurable. When, in this state, they are turned out and used for breeding. The result is very extraordinary: the colts born from parents which have been taught the ambling pace, have themselves the amble, as naturally as the colts in Europe have the trot. To these colts is given the name of *aguilillas*. The first importation of dogs into South

America, was at the second voyage of Columbus. In his first battle with the Indians in South America, he had twenty blood hounds, which were afterwards employed in Mexico and New Grenada, where their race remains almost without change. They are now used chiefly for stag-hunting; and are as formidable in their attack upon that animal, as they were formerly to the natives. Many of the South American dogs of pure race inherit the necessary instinct for the chase of the wild hog, in which they are employed. The address of this dog consists in moderating its ardour, so as not to attack any particular animal, but to keep in check the number by which it may be surrounded; whereas a dog of bastard race, whatever may be its strength, is, for want of this precaution, instantly devoured. The sheep introduced into America were not the *merinos*, but the two species called *tana basta* and *burda*. In temperate climates, they have multiplied abundantly, without shewing any tendency to submit to the domination of man. In the burning climate of the plains, they do not propagate freely; and a curious phenomenon is there witnessed. The wool of the lambs grows at first, as in more temperate climates, but rather slowly. When in a fit state for shearing, there is nothing remarkable about its quality; and, when removed, it grows again as in temperate climates: but if the proper time for shearing is allowed to go by, the wool becomes thick, falls off in patches, and leaves underneath, not a new growth of wool or a barren place, as if from disease, but a short shining and close hair, exactly like the hair of the goat, in the same climate: and, where this hair once appears, there is never any return of wool. The goat, notwithstanding its form, which appears adapted to mountainous situations, thrives much better in the low valleys of South America, than on the high points of the Cordilleras. It undergoes a lactiferous change similar to that of the cow. Among birds, the changes have not been great. The fowls brought by the Spaniards multiplied abundantly in most situations; but, on some elevated points, such as Cusco, and all the valley, it was for a long time impossible to get them to propagate. By dint of perseverance, a few chickens were obtained. In these there was little fecundity; but their descendents were more fruitful, and they now produce with the same facility as in our climates.

The same remark may be made of the goose, which has only been recently introduced into Bogota. The peacock, guinea-fowl, and pigeon, have undergone no change. The conclusions drawn from the report are, 1*st*, That every animal, like man, requires time to accustom itself to climate; and, 2*dly*, that domestic animals, when left to themselves, have a great tendency towards the organization of those of the same species in a wild state; and that a very short time only is necessary to produce that transformation.

## BOTANY.

14. *Hybrids produced by Species of Rhododendron, Azalea, and Rhodora fertilizing each other.*—It has been found that the flowers of different species of the genera Rhododendron, Azalea, and Rhodora, fertilize each other, and produce hybrids of endless variety; rendering it doubtful whether the generic distinctions be well founded. This has occurred at the Earl of Liverpool's collection of American plants at Coombe Wood; and still more remarkably, at the Earl of Caernarvon's extensive collection at High Clerc. Mr Gowen, who has paid particular attention to hybrid productions, mentions, that at High Clerc, he saw above a hundred seedling hybrids raised from different varieties of *Azalea viscosa* and *nudiflora*, which had been fertilized with the pollen of Rhododendrons intermediate between *R. ponticum* and *R. catawbiense*. These hybrids are evergreen in ordinary winters, like the Rhododendrons; but, in severe frost, shew a tendency to shed their leaves, like the Azaleas.

## ANTHROPOLOGY.

15. *Craniology.*—It is in the brain, then, that we are tempted to place the seat of reason; and as it appears that the human brain excels that of the monkey, by the number and intricacy of its folds and convolutions, so should we analogically be led to suppose, that the difference in mental endowments, between one man and another, may be connected with a greater amplitude of the surface of the brain, in those who are the most highly gifted. Then it is certain that the skull is formed after the brain, and moulded upon it, and that very moderate attention will enable an anatomist, for the most part, to distinguish those prominences

which are caused by inequalities of the bone, from those which mark the proportions of the brain; so philosophical in its conception was the theory of Gall, which proposed to determine character by reference to the height, and breadth, and prominence of different parts of the skull. The craniological theory seemed to derive support from popular expression and universal prejudice; a long head is a term that has been vulgarly used to describe extent of capacity; and a high forehead has always been looked upon as a mark of superior understanding. It is to be regretted, that an inquiry, which began with so much promise of success, seems likely to end in disappointment. Upwards of thirty years have now been employed, and half the heads of Europe, that were worth it, have been examined, in the attempt to lay down a chart of the brain; and we may suppose, that, if there be an essential relation between the shape of the head and our intellectual and moral endowments, it would not now remain undiscovered. Had such a discovery been made, it would follow, that candid persons, with moderate powers of observation, would be able to trace in the heads of men of marked character and talent, a general confirmation of the craniological theory. For my own part, I profess that I have in this manner studied craniology, but the result has not satisfied me. That craniology should have many supporters, is not surprising; the habit of studying the slighter indications of character, enables men to form, with unusual quickness, a shrewd judgment of the temper and understanding of others; and the more ingenious and clever the observer, the more readily will he be able to reconcile the exceptions which he meets with, with the general truth of his system. When we compare the opposite hemispheres of the cerebrum in animals, the most exact correspondence may be traced between the disposition of the convolutions in both. This is not the case with the human brain; there is a general resemblance, but nothing further; and when we lay side by side different human brains, the order of the convolutions is so various, that, with the exception of those which immediately border the great fissures, no correspondence between each in point of superficial structure can be fairly made out; not even enough to allow a general account of the convolutions of any one brain to stand as a description of their usual position. Possibly the quality of different brains may vary. M. Magendie found that the brain in advanced age is specifically lighter by a fifteenth than in adults. When we turn to physiological experiments, upon the uses of parts in the brains of animals, we find that they afford us no assistance upon the question which we have been last considering; but at the same time, they present us results the most curious and unexpected, and which perhaps the more deserve attention, as their direct physiological interest is yet inferior to their value in pathology.—*Mayo's Outlines of Human Physiology*, p. 298.

16. *On the Duration of Generations in the Eighteenth Century.*—Mr Villot, in a memoir lately read before the Academy of Sciences of Paris, after mentioning that the duration of human generations was long confounded with the mean duration of life, and that M. Fourier is the only person who has defined the duration of generations in a clear and precise manner, shewed, that, in this question, which is so interesting to natural history and chronology, there may be considered for both sexes, the duration of generations of first-born parents, and the common duration of generations. The duration of the generation of first-born persons presents no other interest than what relates to the royal races, and the common duration of races is what it is of importance to determine. He then shewed, that the only practicable method of conducting this inquiry in a useful manner, with reference to legal and authentic documents, is to have recourse to the public registers; but that these registers having been accurately kept only during the eighteenth century, it is only from that period that such inquiries can be made in France. He then gave an account of the method which he employed in determining the mean duration of generations in Paris in the eighteenth century; that is to say, in finding the mean value of the interval of time between the birth of a father and the birth of one of his sons, without regard to the order of their birth. This method has the inconvenience of supposing but one generation for a family; but this inconvenience disappears when the question refers to a great number of families taken at random in each of the parishes of Paris, and from all the registers of the century. To determine the generation of a family, M. Villot took from the registers the date of the birth of a male child, and followed up the series of its parents to the commencement of the

century. By this method, which embraced the whole century, and which avoided the special circumstances of the inhabitants as to their place of residence, their station in society, and the order of birth of their children, the author collected, 1*st*, 482 observations, from which there results, that, in Paris, during the eighteenth century, to the time of marriage, the mean age of a man has been 29 years 68 hundredths, and that of a woman 24 years 72 hundredths; and that thus the difference of age between the two engaging parties has been, as a mean term, 4 years 96 hundredths. 2*dly*, With respect to the generation of a family, M. Villot procured 505 observations for the male sex, and 486 for the female. These latter shew, that, in Paris, during the eighteenth century, up to the period of birth of a son, the mean age of a mother was 28 years 17 hundredths; while, from 505 observations relative to the male sex, there results, that, in Paris, during the same century, the mean age of a father, at the period of the birth of a son, was 33 years 31 hundredths. This interval representing the duration of a male generation, it follows that there have been about three generations at Paris in the eighteenth century. M. Villot remarked, that this duration coincides with that which was adopted by the Greeks in their chronological calculations,—a remarkable result, if we consider the difference of manners of the two nations, and of the climate of the two countries. In order to determine the degree of confidence which the mean numbers obtained by his observations merit, M. Villot has applied to his investigation a rule of M. Fourier's, calculated to make known the limit of the error which a mean value furnished by a certain number of observations may present; and there results from this application, that the limits of the mean of these numbers do not exceed two months, more or less; and hence, that these numbers are the true expression of the mean value sought, since it is certain that, by repeating this operation, a great number of times, and by comparing together the numbers obtained by the new operations, it would turn out that the number which would express the union of all those which would surpass the value in question, divided by the number expressing the union of those which would be beneath that same value, would give for a quotient unity, or a fraction very near unity; or, in other terms, that the probability of the limits of this error is represented by the fraction one-half, since there is one to one, or one to two, to be laid that the error which may have been committed will not exceed the limit of two months and a fraction, and as much to lay that it will surpass them in its limits.

## ARTS.

### 17. *Extent of the Iron Trade of Great Britain.*

In the year 1740, the whole iron made in Great Britain was 17,000 tons, from 59 furnaces.
In 1788, it had increased to 68,000 tons, from 121 furnaces.
In 1796, it had increased to 125,000.
In 1806, it had increased to 250,000.
In 1820, it had increased to 400,000.
In 1827, it had increased to 690,000 tons, from 284 furnaces.

The different counties in which it is made are as under in 1827:

| | | |
|---|---|---|
| Staffordshire, | . | 216,000 tons, from 95 furnaces. |
| Shropshire, | . | 78,000 tons, from 31 furnaces. |
| South Wales, | . | 272,000 tons, from 90 furnaces. |
| North Wales, | . | 24,000 tons, from 12 furnaces. |
| Yorkshire, | . | 43,000 tons, from 24 furnaces. |
| Derbyshire, | . | 20,500 tons, from 14 furnaces. |
| Scotland, | . | 36,500 tons, from 18 furnaces. |
| | | 690,000 tons. 284 furnaces. |

About three-tenths of this quantity are of a quality suitable for the foundry, which is all used in Great Britain and Ireland, with the exception of a small quantity exported to France and America. The other seven-tenths are made into bars, rods, sheets, &c. of which a large quantity is exported to all parts of the world.—*Repertory of Arts, October* 1828, *and Annals of Phil. for Nov.* 1828.

18. ***Russian Coinage of Platina.***—A letter from Professor Breithaupt to Dr Schweigger, an extract of which is given in a late number of the *Jarhbuch der Chemie, &c.* confirms the statement some time since made by the newspapers, that the Russian Government had resolved to coin a large sum in Siberian platina. It appears that Count Denidoff, the proprietor of the locality where the platina was discovered, has disposed of to the government the quantity of that metal which

had been collected. He has sent four young Russians, destined for official situations in Siberia, to be educated in the mining Academy of Freyberg.—*Annals of Phil. Dec.* 1828.

19. *Apparatus for the Sounding of Church-Bells, invented in Denmark.*—It is well known, that buildings suffer much from the sounding of bells, especially when they are very heavy. Let one, in fact, only imagine a mass of several tons swinging to and fro, and he will readily perceive how much a building must be shaken by it. It has long been tried to invent proper means of sounding bells without pulling. These means have hitherto consisted in striking the bell with a hammer or clapper, put in motion by a machine, which may be made to go fast or slow. The intervals, however, are rarely equal, and the clapper or hammer, after each blow, remains some time in contact with the bells, rendering the sound less distinct. Some of these inconveniences have been removed by a machine, invented by the Danish smith Soendsen. This machine, however, had the defect of being too complex, and of not being founded on the law of free oscillations. On the occasion of suspending a new bell in the belfry of the church of Nôtre Dame, at Copenhagen, Professor Oersted endeavoured to improve Soendsen's machine. For this purpose, he introduced into it a balance, similar to that of a pendulum. An axis, by turning, raises a hammer, which, at each turn, strikes the bell, and produces a sound which cannot be distinguished from that emitted by the bell when tolled. This mechanism has the additional advantage of requiring only a single person, whereas, to toll bells, it sometimes requires so many as ten. The motion of the axis may be accelerated or retarded. Perhaps, also, by means of the new apparatus, the same sound may be obtained from a much smaller mass of metal. Professor Oersted hopes that the ideas here emitted will excite other persons to improve the sounding of bells. We recommend this subject to the attention of the magistrates of our different towns.—*Oversigt over det kong. danske Videnskab; Selskabs forhandl.;* 1827, p. 15.

# NEW PUBLICATIONS.

1. *Elements of Natural History, adapted to the present State of the Science.* By JOHN STARK, F. R. S. E. M. W. S. &c. Two volumes 8vo, with Plates, Edinburgh.

A good many years ago, we advised our late excellent friend, Mr Charles Stewart, to draw up such a view of the animal kingdom as would interest naturalists, and general readers, and, at the same time, answer as a text book for the Lectures on Zoology delivered in the University. His "Elements of Natural History," published in 1809, was such a work. During his lifetime, it passed through two large editions, a sufficient proof of its various excellencies. For some years the work has been out of print, although much in demand, and no similar one having appeared in this country, Mr Stark was induced to prepare and publish the present work. It is on the plan of Stewart's; but carefully and judiciously brought up to the present state of the science of zoology. In the Introduction, our author defines the object of natural history, mentions the division of natural bodies into organic and inorganic, comprehending the three kingdoms of nature, the Animal, Vegetable, and Mineral, and gives a general outline of the peculiar characteristics of each, together with remarks on life, organization, nutrition, circulation, generation, locomotion, sensation, structure, instincts and habits of animals. Each division of the animal kingdom is introduced with observations on the structure and classification of the objects referred to it. The genera of all the classes, excepting two, viz. the Insects and Entozoa, are characterised; several of the species of each genus are more commonly given; and these are, for the most part, accompanied with brief but interesting remarks. In the different classes, the best authorities have been followed, viz. Desmarest, Temminck, Cuvier, Lamarck, Leach, Latreille, and Rudolphi. Twelve useful plates are given, illustrative of the terms used in the description of the different groupes of animals; and, what is of great importance, each volume is provided with an ample index. The work is professedly, in some degree, a compilation, but is every where well executed; and there is enough in these two closely printed volumes, containing 1052 pages, to initiate the student, in some measure, into the vast system of animated nature. It is the only portable work in our language which affords a popular, and, at the same time, a strictly scientific view of the animal kingdom; and hence it cannot but prove very acceptable to the zoologist commencing his studies, and also to those more advanced, who have not the means of procuring more voluminous and expensive works.

2. TURNER's *Elements of Chemistry*. In one volume 8vo. 2d Edit.

We have carefully examined this new edition of Dr Turner's work. It is much enlarged, and every way so much improved, that it may be considered, for its size, as the best view of philosophical and practical chemistry in our language.

3. *An Essay on the Study of the Animal Kingdom; being an Introductory Lecture delivered in the University of London.* By Dr GRANT, Professor of Zoology and Comparative Anatomy.

The perusal of this amusing discourse has gratified us not a little. It displays the acuteness and varied information of its author, and is well calculated to arrest the attention and excite the curiosity of those to whom it was addressed.

4. *Picture of Organized Nature in its distribution over the Earth.* Translated from the German of WILBRAND and RITGEN.

This curious view of the distribution of animals and plants over the globe is accompanied by a splendidly coloured map, illustrative of the distribution of organic beings. The map is on a novel plan, and can only be well understood by actual examination. Those who feel interested in this delightful department of natural history, will, we doubt not, procure this memoir and map; for which the public is indebted to Mr C. Smith, mapseller, London.

5. *Zoological Researches, and Illustrations in Natural History; illustrated by numerous Figures.* By JOHN V. THOMPSON, Esq. F. L. S., Surgeon to the Forces. No. I. Cork.

In a former number of this Journal, we expressed a favourable opinion of Mr Thompson's memoir on the *Pentacrinus europeus*; and have now the pleasure of announcing the publication of the first number of the "Zoological Researches;" a work intended to record descriptions and histories, with figures of nondescript or imperfectly known animals. The present number contains two memoirs, one on the metamorphoses of the Crustacea, and on the genus Zoea; the second on the genus Mysis, or Opossum-shrimp. Both are illustrated by accurately drawn and neatly engraved outlines of structure and form of the animals described. In the first memoir, the author, after some observations on the luminosity of the sea,—which phenomenon is partly occasioned by species of the Zoea tribe,—next details those observations which have enabled him to ascertain that the Zoea, and probably many of the Decapodous Crustacea, undergo a metamorphosis, by which they pass from the state of swimming to that of crawling animals. This we consider a curious and important discovery; and, independent of other considerations, enables us to explain what appears to many naturalists so paradoxical,—the annual peregrinations of land-crabs to the sea-shore. The memoir on the genus Mysis, or Opossum-shrimp, a small group of the Crustacea, is not only instructive, but must prove amusing, even to those who in general feel little disposed to take an interest in the minute, but wonderful, creatures with which the waters of the ocean are peopled. This highly meritorious work, we doubt not, will be extensively patronized by the naturalists of this and other countries.

### 6. M. de la Beche's *Table of Formations.* 2d Edition.

In a former occasion, we reported favourably of the first edition of this interesting work. The present is no less worthy of patronage, as it contains a good deal of new and useful information. As another edition may be expected of a table, which every geologist ought to possess, we hope the author will abandon the names medial, super-medial, &c. which are not so appropriate as those already in general use; and, besides, are not likely to be adopted.

## *List of Patents granted in England from 24th July to 16th October 1828.*

1828,

July 24. To A. Bernhard of Finsbury Square, for his "method of raising water."

To R. Wornum of Wigmore Street, for "improvements on upright piano-fortes."

Aug. 5. To J. C. Daniell of Lumphrey Stoke, Wiltshire, for "certain improvements applicable to the manufacturing and preparing of woollen cloth."

11. To J. L. Higgins of Oxford Street, Esq. for "improvements on wheel-carriages."

To W. Mencke of Park Place, Peckham, Surrey, for "improvements in preparing materials for, and in making, bricks."

To L. R. Fitzmaurice of Jamaica Place, Commercial Road, Middlesex, for his "improvements on ship and other pumps."

To W. Grisenthwaite of Nottingham, Esq. for "a new process for making sulphate of magnesia, commonly called Epsom Salts."

13. To H. Maxwell of Pall Mall, for "an improvement in spring spur-sockets."

16. To T. Striling of the Commercial Road, Lambeth, for "improvements on filtering apparatus."

18. To B. M. Payne of the Strand, scale-maker, for "improvements on weighing machines."

19. To E. Barnard of Nailsworth, near Minchinhampton, Gloucester, for "improvements in weaving and preparing cloth."

To P. Foxwell, W. Clark, and B. Clark, all of Dye-House Mill, Minchinhampton, Gloucester, for "improvements in machinery for shearing and finishing woollen and other cloths."

To W. Sharp of Manchester, for "improvements in machines for spinning or roving of cloth, silk, wool, &c."

28. To G. Stratton of Frederick Place, Hampstead Road, for "an improvement in warming and ventilating buildings."

Sept. 4. To Granville Sharp Pattison of Old Burlington Street, Esq. for "a method of applying iron in the sheathing of ships, and of applying iron-bolts, spikes, nails, and other fastenings, in ships and other vessels."

To J. Seaward and S. Seaward of the Canal Iron-works, Poplar, for "a new method for propelling carriages on roads, and also ships and other vessels on water."

To C. Sanderson of Park Gate Iron-works, near Rotherham, Yorkshire, for "a new method of making sheer steel."

To Admiral S. Brooking of Plymouth, for his "new mode of making sails of ships and other vessels."

To J. Robertson of Limehouse Hole, Poplar, for "improvements in the manufacture of hempen rope or cordage."

Sept. 4. To W. Bell of Lucas Street, Commercial Road, Middlesex, for "improved methods for filtering water and other liquids."

To W. Farish, Jacksonian Professor in the University of Cambridge, for "an improved method of clearing out water-courses."

11. To T. R. Williams of Norfolk Street, Strand, for "improvements in the making of hats, &c. and in the covering of them with silk and other materials with the assistance of machinery."

To T. Minikew of Berwick Street, for "an improvement in the making of chairs, sofas, beds, and other articles of furniture for similar purposes, and also of travelling and other carriages for personal use."

To J. B. Neilson of Glasgow, for "the improved application of air to produce heat in fire forges and furnaces where bellows or other blowing apparatus are required.

18. To L. W. Wright of Mansfield Street, Borough Road, Surrey, for "improvements in machinery for making screws."

To W. Losh of Benton House, Northamptonshire, Esq. for "improvements in iron-rail for rail-roads, and of the chains or pedestals in or upon which the rails may be placed or fixed."

To J. Rhodes junior of Alverthorp, Wakefield, for "improvements in machinery for spinning and twisting worsted yarn and other fibrous substances."

To J. C. Daniell of Limpley, in the parish of Bradford, Wiltshire, clothier, for his "improvements in the machinery used for dressing woollen cloth."

To J. Melville of Upper Harley Street, for "improvements in propelling vessels."

To E. F. Orson of Prince's Square, Finsbury, for "an improved cartridge for sporting purposes."

25. To J. Jones of Leeds, for "improvements in machinery for pressing or finishing woollen cloths."

To P. Rigby Watson, Esq. of the Middle Temple, barrister-at-law, for "improvements in stick sealing wax."

To J. Neville of New Walk, Shad Thames, Surrey, for his "apparatus for obtaining mechanical power from falls and streams of water."

Oct. 2. To T. Fowler of Great Torrington, Devon, for "improvements in or for raising and circulating hot water, hot oils, and other hot fluids for domestic and other purposes."

To J. Brunton of West Bromwick, Stafford, engineer, for "improvements in the apparatus for manufacturing coal-gas and coke."

To D. Napier of Warren Street, Fitzroy Square, for "improvements in machinery applicable to letter-press printing."

To T. Tippet of Gwennap, Cornwall, for "improvements in the construction and working of engines with steam and air, and in the boiler or generator of steam, and in the application of such improved engines to a new method of propelling of vessels and other floating bodies."

9. To S. Lawson and M. Walker of Leeds, for "improvements in machinery for preparing and dressing hemp, flax, silk, &c."

To H. Duxbury of Pomeroy Street, Kent Road, for "a new machine for splitting hides and skins."

16. To E. Hancorne of Skinner Street, London, for "certain improvements in making nails, communicated from abroad."

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## *List of Patents granted in Scotland from 9th September to 6th December* 1828.

1828,

Sept. 9. To Joshua Taylor Beale of Church Lane, Whitechapel, in the county of Middlesex, Engineer, and George Richardson Porter of Old Broad Street, in the city of London, merchant, for "a new mode of communicating heat to various purposes."

22. To Granville Sharp Pattison of Old Burlington Street, in the city of Westminster, and county of Middlesex, engineer, for an invention communicated to him by a foreigner residing abroad, "of a new and improved method of applying iron in the sheathing of ships, and other vessels, and of applying iron-bolts, spikes, nails, pintals, braces, and other fastenings used in the construction of ships and other vessels."

Oct. 1. To James Beaumont Neilson of Glasgow, in the county of Lanark, in North Britain, engineer, "for the improved application of air to produce heat in fires, forges, and furnaces, where bellows or other blowing apparatus are required."

6. To Andrew Motz Skene of Jermyn Street, in the county of Middlesex, Esq. for "a new method of propelling vessels; which method is also applicable to other purposes."

To Edward Forbes Orson of Prince's Square, Finsbury, in the county of Middlesex, gentleman, for "an improved cartridge for sporting purposes."

To Peter Taylor of Hollingwood, in the county of Lancaster, flax-dresser, for "certain improvements in machinery for hackling, dressing, or combing, flax, hemp, tow, and other fibrous materials."

9. To Joseph Blades of Clapham, in the county of Surrey, gentleman, for an invention communicated to him by a certain foreigner residing abroad, for "an improvement in the water-proof stiffening for hats."

Nov. 29. To Samuel Hall of Basford, in the county of Nottingham, manufacturer, for "a method of, and an apparatus for generating steam, and various gases, to produce motive power, and for other useful purposes."

Dec. 6. To John Dickinson of Nashmill, in the county of Hertford, gentleman, for "certain improvements in the method of manufacturing and cutting paper by means of machinery."

# THE

# EDINBURGH NEW

# PHILOSOPHICAL JOURNAL.

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## *Biographical Memoir of M. René-Just Haüy.* By Baron Cuvier *.

The history of the sciences presents some periods during which the human mind seems to have taken an extraordinary flight. When long years of quiet studies have accumulated facts and experiments, and when the theories which have hitherto prevailed no longer embrace them, the ideas that are formed of nature become in some measure incoherent and contradictory: they no longer form a whole, and there is on all hands perceived the necessity of a new chain to connect them. A genius then arises, powerful enough to raise himself to points of view, whence he can seize a part of those relations which are sought after. He inspires an unknown courage in his contemporaries. Each darts with ardour into this domain, where new paths are traced out. Discoveries succeed with increasing rapidity. It might be said, that the men who have the good fortune to connect their name with his belong to a privileged race. Their disciples, those whose youth has been witness to this great movement, fancy they see in them superior beings; and when the time arrives at which they are successively to pay the tribute due to nature, the generation which remains deplores in them a race of heroes which it despairs of ever seeing equalled.

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* Read before the Institute of France.

Such was undoubtedly the fact with respect to the natural sciences at the close of the eighteenth century. The laws of motion reduced to a single formula,—the entire heavens submitted to geometrical measurement,—its spaces enlarged, and peopled with new stars,—the orbits of planets fixed more rigorously than ever, both in time and space,—the earth weighed as in a balance,—man raising himself into the clouds, and traversing the seas without the aid of the winds,—the complicated mysteries of chemistry reduced to a few simple and easily intelligible facts,—the catalogue of natural beings extended in a tenfold degree in all its departments,—their relations established in an irrevocable manner, upon the basis of their internal and external structure,—the very history of the earth in the remote ages studied on monuments, and not less astonishing in its truth, than it could have appeared in the conceptions of fancy:—Such is the magnificent and unparalleled spectacle which it has been given us to contemplate, but which also renders bitter to us the disappearance of the great men to whom we are indebted for it. A few years have seen descending to the grave the Lavoisiers, the Priestleys, the Cavendishes, the Campers, the Saussures, and the Lagranges; and who will not be alarmed at the acceleration of our losses, when a few months have removed from us Herschel and Delambre, Haüy and Berthollet, and our powers are scarcely sufficient to render them, within the prescribed time, the homage due to them from the societies of which they were the ornaments?

We should be the more induced to believe that M. Haüy experienced this irresistible influence of his epoch, from the circumstance that it was almost without having thought of it that he was impelled into a career for which, during forty years, he had taken no care to prepare himself. In the midst of obscure occupations, an idea struck him,—a single idea, but luminous and fertile. Henceforth he pursued it without intermission: his time, his faculties, his all, he devoted to it; and his efforts at length obtained the most magnificent recompence. Nor can any example shew better than his, what great, I would almost say miraculous results, may be elicited by the man who attaches himself with obstinate perseverance to the profound study of one object, and how true the proposition is, at least with reference to the exact sciences, that it is the patience of an energetic mind, when it is invincible,* that really constitutes genius.

**René Just Haüy**, honorary Canon of Nôtre Dame, member of the Royal Academy of Sciences of France, and of most of the learned societies of Europe and America, was born at St Just, a small country town in the department de l'Oise, on the 28th February 1743. He was the elder brother of the late M. Haüy, so well known as the inventor of a mode of instructing persons born blind. Their father was a poor linen manufacturer, who probably would not have been able to give them any other profession than his own, had he not been assisted by the generosity of others.

The first improvement in the fortune of these two young men, arose from a disposition to piety which the elder had evinced from his earliest years, and which prevailed during his whole life.

While yet a mere child, he took singular pleasure in religious ceremonies, and especially in church music; for his musical taste, that natural ally of the finer feelings, happily blended itself with his propensity to devotion. The prior of an abbey of Premontrés, the principal establishment of his native place, who had remarked his assiduous attendance on divine service, took an opportunity one day of conversing with him, and perceiving the vivacity of his intellect, made some of his monks give him lessons. The progress of the child promptly responding to the care of his teachers, they became more and more interested in him, and made his mother understand, that, if she could only take him for some time to Paris, she would ultimately, through their recommendations, obtain some assistance in enabling him to complete his studies.

That excellent woman had scarcely sufficient means to enable her to live a few months in the capital; but she chose rather to expose herself to all privations, than give up the expectations which she had been taught to cherish with respect to her son. Her parental affection, however, was long before it was aided by any effectual encouragement. A young man, whose name was one day to fill all Europe, found no other means of subsistence than the office of a singing-boy in a church of the Quartier

St Antoine. "This post," he afterwards ingenuously said, "was at least so far agreeable, that I had not to conceal my talent for music in it;" and in fact, always faithful to his early predilections, he became a good musician, and acquired considerable proficiency on the violin and harpsichord, two instruments with which he always amused himself. At length, the influence of his protectors at St Just procured a bursary for him in the College of Navarre; and it was only then that he was enabled to find leisure for his classical studies.

His good conduct and application excited towards him at Navarre the same interest as at St Just, and, at the period when he ceased to be a scholar there, the heads of the establishment proposed to him to become a fellow-teacher. He was employed as maitre de quartier; and, as soon as he had taken his degrees, the teaching of the fourth class was confided to him, when he was as yet only twenty-one years of age. Some years after, he went to the College of the Cardinal Lemoine, as teacher of the second class; and to these useful, but humble offices, he seemed to have confined his ambition. In reality, he had acquired at Navarre, under the late M. Brisson of that academy, a taste for experiments in physics, and at his leisure moments he made some on electricity. But this was more a relaxation than a study. As to natural history, properly so called, he had no knowledge of it, and felt no inclination to engage in its study.

Another remarkable circumstance in his history is, that it was to the affectionate dispositions of his heart that he was again indebted for entering upon a career which became so glorious to him; so that it is literally true, that, during his whole career, his renown and his good fortune were rewards of his virtue.

Among the Regents of the Cardinal Lemoine, there was at that time one of the name of Lhomond, a learned man, who, from a feeling of piety, had devoted himself to the instruction of youth. Although very capable, as to writing and speaking, for teaching all the classes, he would not rise above the sixth, and only composed little works for children, but which, from their clearness, and the tone of simplicity which pervades them, have obtained more success than many works of greater pretensions. A great conformity of character and sentiments induced

M. Haüy to choose this man as the friend of his heart, and the director of his conscience. Devoted to him as a child, he assisted him in his business, tended him in his sickness, and accompanied him in his walks. Lhomond was fond of botany, and M. Haüy, who had scarcely heard it spoken of, experienced daily the chagrin of not being able to give this additional pleasure to their intercourse. He discovered, in one of his vacations, that a monk of St Just also amused himself with plants. He instantly conceived the idea of agreeably surprising his friend, and, with this view alone, he besought the monk to give him some lessons in the science, and make him acquainted with a certain number of species. His heart assisted his memory. He comprehended and retained all that was shewn him; and nothing could equal Lhomond's surprise, when, on his first excursion, Haüy named to him, in the language of Linnæus, most of the plants which they met with, and shewed him that he had studied their structure in detail.

Henceforth every thing was common to them, even to their amusements; but from this period, also, M. Haüy became completely a naturalist, and an indefatigable one. It might be said that his mind was suddenly awakened to this new kind of enjoyment. He made a herbarium with extraordinary care and neatness*, and thus early accustomed himself to the employment of method. The Royal Garden was near his college, and it was natural that he should often walk in it. The numerous objects which he there saw, extended his ideas, and exercised him more and more in classifying and comparing. Seeing the crowd one day entering to hear M. Daubenton's lecture on mineralogy, he entered along with it, and was delighted to find in that science an object of study still more congenial than plants to his first taste for physics.

But the Royal Garden had a great number of pupils, and M. Daubenton many hearers, who left botany and mineralogy such as they found them. Perhaps they knew the one and the other better than M. Haüy, because they had studied them earlier; but this longer habit of study was precisely what had familiarized them with difficulties which the force of habit rendered them now unable to perceive. It was on account of having learned these sciences at a later period, that M. Haüy viewed them in a different light. The contrasts, the voids in the series of ideas, made a vivid impression upon a strong mind, which, at the period of its full vigour, entered all at once upon a new study. He was deeply astonished at the constancy exhibited in the complicated forms of flowers, of fruits, and of all the parts of organized bodies, and did not conceive that the forms of minerals, which were much more simple and in a manner all geometrical, were submitted to similar laws; for at this period there was not even known the kind of semi-approximation which Romé de Lisle proposed in the second edition of his *Crystallographie* *. How, said M. Haüy, should the same stone, the same salt, shew itself in cubes, prisms, and needles, without their composition changing an atom; while the rose has always the same petals, the acorn the same curvature, the cedar the same height and the same developement?

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* He employed a peculiar method, which has preserved the colours of the flowers to the present day. See his observations on the manner of making herbaria, in the volume of the Academy for 1785, p. 210.

It was when he was filled with these ideas, that, examining some minerals along with one of his friends, M. Defrance, a teacher of arithmetic, he had the fortunate awkwardness to let fall a fine group of calcareous-spar, crystallized in prisms. One of these prisms broke in such a manner as to shew on its fracture, surfaces not less smooth than the external, and which presented the appearance of a new crystal, entirely differing in form from the prism. M. Haüy picked up this fragment: he examined its surfaces, their inclinations and angles. To his great surprise, he discovered that they were the same as the rhomboidal or Iceland-spar.

A new world seemed at the moment to open itself to him. He retired to his cabinet, took a piece of spar crystallized in the form of a hexahedral pyramid, commonly called *dog's tooth spar*, broke it, and found still the same rhomboid as in Iceland spar. The fragments which fell from it were themselves small rhomboids. He broke a third crystal, one of the kind named *lenticular*. It also shewed a rhomboid in the centre, and the small fragments were of the same form.

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* It only appeared in 1783.

*All is found!* he exclaimed: the molecules of calcareous spar have but one and the same form; it is by being variously grouped that they compose those crystals which deceive us by the variety of external forms which they assume. Proceeding from this idea, it was very easy for him to imagine that the layers of these molecules being heaped upon each other, and contracting proportionally, should form new pyramids or new polyhedrons, and envelope the first crystal as with another crystal, in which the number and figure of the external surfaces would differ much from the original surfaces, according as the new layers might be diminished on a particular side, or in a particular direction.

If this were the true principle of crystallization, it could not fail to be observed in the crystals of other substances. Each of them would have identical constituent molecules, a nucleus always similar to itself, and laminæ or accessory layers, producing all the varieties. M. Haüy did not hesitate about breaking his small collection to pieces. His crystals, those which he had obtained from his friends, were reduced to fragments under the hammer, and in all of them he found a structure founded on the same laws. In garnet, it was a tetrahedron; in fluor-spar, an octahedron; in pyrites, a cube; in gypsum and heavy spar, oblique four-sided prisms, but with bases of different angles, that formed the constituent molecules. The crystals always broke in laminæ parallel to the faces of the nucleus; the external surfaces could always be conceived as resulting from the decrement of the superimposed laminæ, a decrement varying in its rapidity, and sometimes taking place by the angles, sometimes by the edges; the new faces are but small stairs or small rows of points produced by the retreat of these laminæ, but which appear smooth to the eye on account of their great tenuity. None of the crystals which he examined offered an exception to his law. He exclaimed a second time, and with more confidence, *all is found.*

But to make assurance complete, a third condition was to be fulfilled. The nucleus and constituent molecule having each a fixed form, geometically determinable in its angles and in the relation of its lines, each law of decrement ought also to produce determinable secondary faces; and even, the nucleus and the molecules being once given, the angles and lines of all the secondary faces which the decrements might produce, ought to be capable of being calculated beforehand. In a word, it was necessary here, as in astronomy, and in physics, that, before the theory could be admitted as certain, it should explain with precision the known facts, and foresee with equal precision those which were not yet known.

M. Haüy was sensible of this; but in the last fifteen years, during which he had passed the better part of his life in teaching Latin, he had almost forgotten the little geometry that he had acquired at college. He was not discouraged, however, but sat down quietly to learn it again. He who so quickly learned botany to please his friend, soon made himself master of as much geometry as was necessary for completing his discovery, and from his first trials he found himself amply recompensed. The hexahedral prism which he had inadvertently broken, gave him, by an ingenious observation, and sufficiently simple calculations, a value very near the angles of the molecule of the spar. Other calculations gave him those of the faces which were added to it by each decrement; and on applying the instrument to the crystals, he found the angles precisely of the measurement afforded by calculation. The secondary faces of other crystals were with equal ease deduced from their primitive faces. He even discovered, that to produce the secondary faces, it generally required only decrements in proportions sufficiently simple, as are in general all the numerical relations established by nature. It was then that, for the third time, and henceforth without hesitation, he could say, *I have found all*; and it was then also that he took courage to speak of his discoveries to his master M. Daubenton, whose lectures he had hitherto attended modestly and in silence. It may be judged with what favour they were received. M. de Laplace, to whom M. Daubenton communicated them, instantly foresaw all their consequences, and hastened to encourage the author to come and present them to the Academy *.

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* His first memoir, in which he treated of the garnets and calcareous spars, was read there on the 10th January 1781.

Daubenton and Bezout made the report of it on the 21st February; but it is easy to see, on reading this report, that they had not yet fully appre-

It was not very easy to persuade M. Haüy to do so. The Academy and the Louvre were to the good regent of the College of the Cardinal Lemoine a sort of foreign country which alarmed his timidity. The customs were so little known to him, that, at his first readings, he went there with the long dress which the old canons of the church, it is said, prescribe, but which ecclesiastics who were not in office had long ceased to wear in society. At this period of levity, some friends dreaded that this dress would prevent his being admitted; but before he could be made to relinquish it (and this is another trait in his character), it was necessary that their advice should be supported by the opinion of a doctor of the Sorbonne. "The old canons of the church," said this sage person, "are very respectable, but at this moment your business is to look after the Academy." It is to be presumed, however, that this was a superfluous precaution, and from the haste which the Academy shewed to acquire him, it may easily be seen that they would have taken him, whatever dress he wore. They did not even wait until a place in physics or mineralogy was vacant, and some arrangements having made one in botany disposable *, it was given to him almost with one voice, and in preference to several learned botanists †.

He received a still more flattering testimony of the esteem of his new colleagues. Several of the most distinguished among them besought him to give them oral explanations and demon-

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hended the nature of the discovery. This memoir is printed by extract in the Journal de Physique of 1782, t. i. p. 366.

The second memoir, in which he confines himself to the calcareous spars, was read on the 22d August 1781, and its report was made by the same commissioners on the 22d December. This time they perfectly apprehended the author's ideas and their importance. The memoir is printed in the Journal de Physique of 1782, t. ii. p. 33.

* It was the adjunct place in the botanical class, left vacant by the promotion of M. de Jussieu to that of associate. M. Haüy's election was on the 12th, and M. Amelot's letter announcing the confirmation of the king on the 15th February 1783.

† MM. Desfontaines and Tessier, who had the second voices, and MM. Dombey and Beauvois. Dombey died before being admitted to the Academy. Beauvois only entered it in 1803. In 1788, M. Haüy passed as associate to the class of natural history and mineralogy.

strations of his theory. He read a course of lectures to them on the subject. MM. de Lagrange, Lavoisier, de Laplace, Fourcroy, Berthollet, and de Morveau, went to the college of the Cardinal Lemoine to hear the lectures of the modest regent of the second class, who was quite confused at seeing himself the teacher of men, whose scholar he would scarcely have ever dared to call himself. In a doctrine so new, and yet already almost complete, the most able men were in fact but scholars. Perhaps no doctrine of so comprehensive a nature was ever presented, which, from the commencement, possessed such clearness and developement, as that exhibited and illustrated by M. Haüy. He had even invented modes of calculation which were essential to his subject*, and had previously represented, by formulæ which were peculiar to himself, all the possible combinations of crystallography.

One cannot learn better than on this occasion what distinguishes those solid works of genius, on which eternal edifices are founded, from those more or less happy ideas which present themselves for a moment to certain minds, but which, for want of being cultivated, produce no lasting fruits.

Six or seven years before Haüy, Gahn †, a young Swedish chemist, who was afterwards professor at Abo, had also remarked, in breaking a crystal of pyramidal spar, that its nucleus was a rhomboid similar to Iceland spar. He had communicated this observation to his master, the celebrated Bergmann, a man of superior mind, and one who might have been thought capable of eliciting all its consequences. But in place of repeating it on different crystals, and of thus discovering, by experiment, within what limits the fact might be generalized, Bergmann gave himself up to hypotheses, and from the first step ran wide of the subject.

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* See his memoir *on an analytical method for resolving the problems relative to the structure of crystals*, in the volume of the Academy for 1788, p. 13.; and *on the manner of reducing to the theory of the parallelopiped that of all the other primitive forms of crystals*, in the volume of 1789, p. 519.

† See in the first volume of the *Nova Acta* of the Academy of Upsal, printed in 1773, p. 150, Bergmann's memoir, entitled, *Crystallorum formæ e spatho ortæ*. It is reprinted in Bergmann's works, Leipsic edition, and Lamétherie inserted a translation of it in the Journal de Physique of 1792, t. xl.

From this rhomboid of calcareous spar he pretended to deduce, not only the other crystals of calcareous spar, but those of garnet and hyacinth, which have no similarity of structure. Thus, a philosopher of the first order, perfectly versed in physics and geometry, stopped short on the path of a beautiful discovery; and it was reserved for a man, who had scarcely begun to occupy himself with science, but who knew how to pursue this truth, as nature would have all her works pursued, by proceeding step by step, observing without intermission, and not allowing himself to be either hurried on or turned out of the path by his imagination.

But for the same reason that other mineralogists had not found the right way, they did not apprehend in what Bergmann's differed from it, and they accused M. Haüy of having borrowed his ideas from him, although he had scarcely heard his name, and had never seen his memoir. They added, as is always done on such occasions, that not only was the discovery not M. Haüy's, but that it was false.

Romé Delisle, a mineralogist otherwise not without merit, but who had been for a long time examining crystals, without so much as imagining the principle of their structure, had the weakness to dispute it, when another had made the discovery. He found it pleasant to call M. Haüy a *crystalloclast*, because he broke crystals, as in the Lower Empire they who broke images were called *iconoclasts*. But, fortunately, we have no heretics in the sciences, excepting those who refuse to follow the improvements of their age; and such at the present day are Romé Delisle, and those who succeeded him in his petty jealousy.

As to M. Haüy, the only reply that he made to his calumniators consisted in new researches, and a still more fertile application of his principle. Hitherto he had only given the solution of a curious problem in physics; but now his observations were to furnish characters of the first importance to mineralogy. In his numerous trials on the spars, he had remarked that the stone called *pearl-spar*, which was then considered as a variety of heavy spar or of sulphate of barytes, has the same nucleus as calcareous spar; and an analysis which he made of it proved that, in fact, like calcareous spar, it only contains carbonate of lime.

If the minerals which are properly determined with respect to their species and composition, he now said, have each its nucleus and its constituent molecule fixed, it must be the same with all the minerals distinguished by nature, and whose composition is not yet known. This nucleus or molecule may therefore supply the composition for the distinction of substances; and from the first application which he made of this idea, he threw light upon a department of science which all the labours of his predecessors had failed to elucidate.

At this period, the most able mineralogists, Linnæus, Wallerius, Romé Delisle [*], and Saussure himself, confounded, under the name of *schorl*, a multitude of minerals, which had nothing else in common than some degree of fusibility, united to a more or less prismatic form; and under that of *zeolite*, a multitude of others, whose sole distinctive character was that of being converted by acids into a sort of jelly. The schorls, especially, formed the most heterogeneous union: all the minerals that were but imperfectly known, were thrown into them: and the late M. de Lagrange, a man whose extensive knowledge and accuracy of perception equalled his genius, said in jest, that schorl was the *nectary* of mineralogists, because botanists were accustomed to designate as a nectary any part of the flower of whose nature they were ignorant.

M. Haüy having divided mechanically the substance called *white schorl*, was quite astonished to find in it the nucleus and molecule of felspar [†]. The late M. Darcet, analyzing it on this indication, in fact, discovered in it all the physical and chemical characters of the felspars.

Filled with new hopes, M. Haüy examined the other schorls, and discovered that the black mineral which occurs imbedded in so many lavas, and which was named *volcanic schorl*, has for its nucleus an oblique prism with rhombic base, and that the alleged *blue schorl* of Dauphiny has a right prism as a nucleus. He therefore separated both from the schorl genus *.

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[*] Cristallographie, tome ii. p. 344, *et seq.*

[†] Notice respecting *white schorl*, read to the Academy on the 28th July 1784, printed in the Journal de Physique of 1786, tom. i. p. 63; and, in 1787, in the Memoirs of the Academy for 1784, p. 270.

At a later period, he distinguished the *electric schorl* or *tourmaline*, from the *black schorl of the primitive mountains*. The nucleus of the former is a regular hexahedral prism, while that of the latter is only tetrahedral †.

He continued his researches. Each of these alleged schorls he found to possess determinate characters, to group itself with the varieties which really belong to it, and to be isolated from those which had been improperly associated with it. Similar operations disclosed the differences between the minerals that had been confounded together under the name of *zeolites* ‡, and in all cases chemistry and physics, excited to action by these results of crystallography, discovered in their turn characters or elements in these minerals, which they had previously failed to bring to light.

From this moment M. Haüy was no longer a mere experimenter in physics: he was preparing himself to become the legislator of mineralogy; and, in fact, it may be said that the new era of that science dates from his researches into the structure of the schorls, and that since this period the study of the crystalline structure of minerals has each year produced some unexpected discovery.

Among the schorls, M. Haüy at length came to distinguish fourteen species. He discovered six among the zeolites, four among the garnets, and five among the hyacinths. In this way, he not only announced to chemists, that, by recommencing their analyses, they would find in these minerals differences of composition which they had misinterpreted, but he also very frequently predicted that the differences, which they imagined they saw, could not exist. And, in this manner, from the indications furnished by crystallography, M. Vauquelin succeeded in finding *glucine* in the *emerald*, as he had previously discovered it in the *beryl.*

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* Notice respecting the Structures of the Crystals of Schorl, read to the Academy on the 30th March 1787, printed in the Journal de Physique of 1787, p. 322.

† Journal d'Histoire Naturelle, tom. ii. p. 67, printed in 1792. Afterwards M. Haüy preferred the rhomboid for tourmaline; but these two forms are not incompatible.

‡ Journal des Mines, No. xiv. p. 86.

Sometimes these indications resulted from M. Haüy's researches, without his having first perceived them himself, for want of having been at the trouble to compare his results. Thus, when MM. Klaproth and Vauquelin had discovered that the *apatite* and *chrysolite* of the jewellers were only phosphate of lime, he found in his papers that he had long before determined the same structure for both these substances. This agreement between operations performed separately, and which could not have been supposed to have been concerted, was in his eyes the triumph of crystallography.

It was the duty of a man who thus served the sciences, to devote himself entirely to them. By the advice of Lhomond himself, M. Haüy, when he had served in the university the twenty years, which were then sufficient to obtain the pension d'émérite, hastened to demand it. He joined to it the produce of a small benefice. The whole was just barely sufficient for his subsistence; but, as he sought no other enjoyments than those afforded by his labours, he would have been satisfied, had he remained in quiet possession of it. Unfortunately he soon learned that the effects of human passions cannot be so easily calculated as those of the powers of nature.

It will be recollected with what imprudence the Constituent Assembly allowed itself to be induced by narrow minds, to add theological disputes to all the others which agitated France, and thus to double the acrimony of political quarrels, by giving them the character of religious persecutions. The new form of government which was imposed upon the church had divided the clergy, and the men who wished to carry the revolution to the extreme, found pleasure in envenoming this division. The ecclesiastics who were not inclined to the innovations, were at first attacked in their fortunes; they were deprived of their places and pensions; and M. Haüy, whom his scrupulous piety had always retained in this class, saw himself in an instant as poor as when he had the ambition of becoming a singing boy.

He would still have been contented to have been allowed to live by his labour; but the persecutors were not satisfied with these first vexations. When, on the 10th August 1792, the throne was overthrown, one of the first measures taken, or allowed to be taken, by the cruelly volatile men who came into the possession of power, was to imprison the priests who had not taken the prescribed oath, and M. Haüy's celebrity in the sciences only afforded an additional motive to make him undergo the common fate.

Very little acquainted in his solitary life with what was passing around him, he was one day surprised to see some rude men violently enter his humble retreat. They began with asking him if he had fire-arms. I have none but these, said he, drawing a spark from his electrical machine, and this little circumstance disarmed these horrible wretches for a moment. But it was only for a moment that it disarmed them. They seized his papers, in which there was nothing but algebraic formulæ. The collection, which constituted his sole property, was thrown topsy-turvy. He was ultimately confined, along with all the priests and regents of this part of Paris, in the seminary of Saint-Firmin, which was contiguous to the college of the Cardinal Lemoine, and which was converted into a prison.

One cell for another, he found little difference in the change. Tranquillized especially by seeing himself in the midst of many of his friends, he had no other cares than to have his drawers brought to him, and to attempt to reduce his crystals to order.

Fortunately he had friends without who were better informed of what was going on.

One of his pupils, who afterwards became his colleague, M. Geoffroy de Saint Hilaire, member of this Academy, lodged in the College of Cardinal Lemoine. Scarcely had he learned what had befallen his master, when he ran to implore in his behalf all whom he thought could be of service to him. Members of the Academy, functionaries of the Jardin du Roi, did not hesitate to cast themselves at the feet of the ferocious men who conducted this frightful tragedy. An order for his deliverance was obtained, and M. Geoffroy eagerly carried it to Saint Firmin's; but he arrived somewhat late, and M. Haüy was so tranquil, and found himself so comfortable, that nothing could induce him to remove that day. The next morning he had almost to be dragged out by force. One yet trembles to recollect that the day after was the 2d of September.

It is very singular that from this period he was no more disturbed. On no account whatever would he have lent himself to the extravagances of this period; but no one ever made to him such a proposal. The simplicity of his manners, and the gentleness of his disposition, saved him from the trial. One day only he was made to appear at the review of his battalion, but he was immediately discarded on account of his bad mien. This was almost all that he knew, or at least all that he saw of the revolution. The Convention at the time when it was acting with most violence, named him a member of the commission of weights and measures [*], and conservator of the Cabinet des Mines[†]; and when Lavoisier was arrested, when Borda and Delambre were turned out of place, M. Haüy, a priest, who had not taken the oath, performing his ecclesiastical functions daily, was the only person who found himself in a condition to write in their behalf, and who did so without hesitation, and without any thing happening to him in consequence. At such a period his escape from punishment was as astonishing as his courage.

It was at the cabinet of the Consell des Mines, and at the request, and with the aid, of that enlightened administration, that M. Haüy prepared his Treatise on Mineralogy, his principal work, and that he published its programme [‡], and the first edition of it [§].

Having at his disposal a great collection, into which the different minerals flowed from all quarters, and employing the aid of young pupils full of ardour and intelligence, which the polytechnic school had prepared for him, and of which several are at the present day eminent mineralogists, he soon redeemed the time which he had consumed in other labours, and in a few years reared that admirable monument of which it may be said that it did for France, what tardy circumstances had done for its author, and that, after ages of neglect, it suddenly elevated it to the first rank in this department of natural history. This book in fact possesses, in the highest degree, two advantages which are very rarely found combined; the first of which is, that it is founded upon an original discovery, entirely resulting from the genius of the author; the second, that this discovery is followed out in it, and applied with incredible perseverance even to the varieties of minerals. Every thing is grand in the plan, precise and rigorous in the details; it is completed like the doctrine itself of which it contains the exposition.

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[*] On the 22d September 1793.

[†] On the 2d August 1794.

[‡] Extrait d'un Traité Elementaire de Mineralogie, published at first in parts in the Journal des Mines, afterwards in a separate 8vo volume, 1797.

[§] Traité de Mineralogie. 4 vols. 8vo., and a quarto volume of plates, Paris, 1801.

Mineralogy, that department of natural history which has for its object the least numerous and the least complicated productions, is yet that which is the least adapted to a regular classification.

The first observers distributed and named minerals in a vague manner, according to their external appearances, and their uses. It was only towards the middle of the eighteenth century that it was attempted to subject them to those methods which had been of so much service to geology and botany. It was imagined that genera and species could be established among them as among organized beings; and it was forgotten that there was wanting in mineralogy the principle which gave rise to the idea of species, namely that of generation, and that even the idea of individuality, such as it is conceived in the organic departments, that is to say, the unity of action of different organs assisting in the maintenance of the same life, could scarcely be admitted.

It is not by matter that the identity of species is manifested in plants and animals, it is by form, as the very name species presupposes. There are not perhaps two men, two oaks, or two rose-bushes, that have the component substances of their bodies in the same proportion, and even these substances are continually changing; they circulate in that abstract and figured space which is named the form of the being, rather than reside in it. In a few years, there will not remain an atom of what composes our bodies at the present day. Form alone is persistent; form alone is perpetuated by being multiplied. Transmitted by the mysterious operation of generation to endless series of individuals, it will successively draw into itself numberless molecules of different substances, but all transitory.

In minerals, on the contrary, where no apparent motion takes place; where the molecules, once placed, remain in their place until a violent cause separates them from each other; where matter, in a word, is persistent, it would seem at first sight that it is of it; or, in other words, of the chemical composition, that the essence of the being must consist. But, on further reflection, we come to understand, that, if the matters themselves are different, they can only be so through the form of their molecules. It is further conceived, that these particular forms of the molecules, and of the different combinations which they form, must necessarily result from determinate total forms. It is even found, that, if there be any thing in mineralogy that can represent the individual, it is these total forms, when they present a regular whole, a crystal, in short; since at least, at the moment when this crystal is formed, all the molecules which constitute it must have contributed to a common movement, and grouped themselves according to a law which was impressed upon them by all. Now, nothing proves that, in this common movement, there could have been involved molecules of another nature which occurred accidentally within the same sphere of action; or that elements or atoms identical in their nature, at the moment when they contracted their first union, could have grouped themselves into different crystalline molecules; and that what the mind conceives as possible, experience makes known as real. It is therefore manifest, that, in these two cases, chemical analysis would only give imperfect ideas of the mineral, and would not be in accordance with its most apparent properties.

Such are, without doubt, the views, of which M. Haüy did not perhaps render a very exact account to himself, but which in some degree guided his genius, or his scientific instinct, and which induced him to give the chief rank to crystallization in all his determinations of mineral species.

It may be said, that all the discoveries and observations made of late years, even those which have been considered as objections to this fundamental rule, are rather confirmations of it.

What we have just said, for example, of the crystallizing power, and of the power which it has of drawing foreign molecules along with the essential molecules, is so true, that it involves the former sometimes in much greater quantity, so that the same mineralogical species, such as sparry iron, which is fundamentally nothing but calcareous spar, or carbonate of lime, may contain so much iron as to amount to a fourth or a third of its weight, and thus become to the metallurgist, in place of a simple mineral, a true ore: that muriatic spar, which also is nothing but a calcareous spar, may envelope grains of sandstone to such a degree as to contain nothing else; and all this without the angles of its crystals changing a second.

It is precisely the same in our laboratories as in the great laboratory of nature. M. Beudant, in making a mixture of two salts crystallize, has seen one of the two constrain the other to mingle with its crystals, in a much greater proportion than would have occurred in it itself. Which of the two is to characterize the mineral? Is it the most abundant? Certainly not: for, this abundance excepted, all the characters of the product are given by the other.

It is not less certain that the same substance at the same moment assumes a very different form from what it commonly has when it is formed into crystals, in which it is individualised, if we may be permitted to employ this expression. All the efforts of chemists have been unable to find any thing essential in arragonite, excepting the same carbonate of lime of which calcareous spar is also composed; for the small portion of strontian which is discovered in it can only be considered as accidental, and yet arragonite crystallizes in the octahedral form, and calcareous spar in the rhomboidal. And here, also, human art is able to imitate nature, and even to make, when it pleases, what nature rarely makes. Recent experiments performed by M. Mitscherlich appear to prove, that certain salts may be made to assume different elementary cystalline forms, according to the circumstances in which they are made to crystallize. But in the small number of cases where nature has itself produced such differences, should we only make a single species of these different crystallizations? Then it would also be necessary to make but one of almost all the warm-blooded animals; for they are as identical in the chemical nature of their elements, as the two minerals which we have just named. An eagle and a dog have the same fibrin in their muscles, the same gelatin in their membranes, the same phosphate of lime in their bones. Like calcareous spar and arragonite, they differ only in the form which these substances have assumed at the moment when they constituted individuals.

I beg to be understood as by no means intending to assert, that the chemical analysis of minerals should be neglected, nor was it M. Haüy's opinion that it should. Their analysis is as necessary for acquiring a knowledge of them as the determination of their form, and is much more important with relation to their uses. What M. Haüy maintained was, that it is generally inadequate to the determination of their species, because it has no sure means of distinguishing the accidental from the essential substances; because it is not in a condition, with respect to certain classes of stones, to affirm that it knows their elements, and because it every day discovers elements which were previously concealed from it *.

The late Werner, whom Europe has long considered as a rival, and even as an adversary, of M. Haüy, differed in reality from him, only in not going so far in the search of principles. The hardness, the fracture, the texture to which he attached himself by preference, are in reality nothing but consequences of the form of the molecules and of their arrangement, and the happy use which that mineralogist made of them for discovering and determining so many mineral species, might already have made all that the source of these, since mere derivations were so prolific. But this source it was reserved for M. Haüy alone, not only to discover, but also to measure its force and plenitude; and it was for him only that it was possible to carry or bring back to their just value many results, which, in Werner's hands, remained in some measure only half truths.

There is scarcely, at the present day, a crystallizable mineral known of which M. Haüy has not determined the nucleus and molecules, with the measure of their angles and the proportion of their sides; and of which he has not referred to these first elements all the secondary forms, by determining for each the various decrements which produce it, and fixing their angles and

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* Tableau comparatif des resultats de la cristallographie, et de l'analyse chimique relativement à la classification des minéraux. 1 Vol. 8vo, Paris, 1809.

faces by calculation. In this manner, he at length made of mineralogy, a science quite as precise and as methodical as astronomy.

It may be said, in a word, that M. Haüy is to Werner and Romé Delisle, what Newton was to Kepler and Copernicus.

But what is entirely peculiar to himself is, that his work is not less remarkable for its regularity, and the method which prevails in it, than for the original ideas on which it rests. The purity of the style, the elegance of the demonstrations, the care with which all the facts are collected and discussed, would have made a classical work of it, had it contained nothing but the most ordinary mineralogy. M. Haüy displays in it the able writer and the good geometrician, as much as the learned mineralogist. We see all his first studies manifesting themselves in it, we recognise in it even his first amusements in physics. If he has to appreciate the electricity of bodies, their magnetism, their action upon light, we find him devising ingenious and simple means, and small portable instruments. The natural philosopher constantly comes, in it, to the aid of the mineralogist and crystallographer.

There are ranks in the sciences which are marked out as soon as the titles to them are produced; and such is that in which M. Haüy indisputably placed himself, the moment when he published his work.

On the death of Daubenton, however, it was Dolomieu, and not M. Haüy, who was named professor of mineralogy to the Museum of Natural History. But Dolomieu was arrested, contrary to all the rules of the laws of nations, and was left to pine in the dungeons of Sicily. His death was generally rumoured: the report was contradicted; and his miserable condition made known through a note written by himself, with a splinter of wood and the smoke of his lamp, and which the gold of a humane Englishman induced the goaler to deliver. These lines spoke in his favour as much as all his works, and one of those whose solicitations were warmest in his favour, was the rival whom he had most to dread; it was M. Haüy.

It might have been thought that such testimonials, and rendered too by such men, would have softened Dolomieu's enemies; but how many people in power, when excited by a momentary passion, no more inform themselves of the sentiments of their contemporaries, than they foresee the indignation of posterity. Dolomieu was released from his subterranean abode only in consequence of a treaty of peace; and a premature death, the fruit of the treatment which he had received, rendered but too soon to M. Haüy the office which he had so generously renounced. He was appointed to it on the 9th December 1802.

From this period the mineralogical department of the establishment assumed a new life. The collections increased in a fourfold degree; there reigned in it an order constantly in conformity to the most recent discoveries, and mineralogists visited it not only with the view of admiring objects so well arranged, but also to hear a professor so elegant, so clear, and so agreeable. His natural benevolence shewed itself immeditately to those who had the desire of acquiring knowledge. He admitted them to his house, opened up his private collections to them, and refused them no explanation. The most humble students were received equally as the most learned personages, and as the most august; for he had pupils of all ranks.

The university, at the time of its foundation, thought it would honour itself by placing M. Haüy's name on the list of one of its faculties. It did not expect lectures from him, and it gave him at the same time an adjunct every way worthy of him, M. Brongniart, now member of this academy, and who succeeded him at the Museum of Natural History. But M. Haüy was unwilling to bear a title without fulfilling its duties. He made the pupils of the Normal School come to him, and, in pleasant and varied conversations, made them acquainted with all his secrets. He then resumed his college life, amused himself with the young people, and especially never sent them away without an ample collation.

Thus passed his days: his religious duties, profound researches unremittingly pursued, and continual acts of benevolence, especially towards youth, occupied them entirely. As tolerant as pious, the opinions of others never influenced him in his conduct towards them; as pious as faithful, the most sublime speculations could not withdraw him from any practice prescribed by the ritual; nor did he attach to the things of this world a higher value than they would naturally present to the eyes of a man penetrated with such sentiments. From the nature of his researches, the most beautiful gems of Europe passed under his eyes; he even wrote a particular treatise on them *; but he never saw in them any thing else than crystals. A degree more or less in some angle of a schorl or spar, would of a certainty have interested him more than all the treasures of both Indies, and, even if he could have been reproached with having formed too lively an attachment to any thing, it was to his ideas on this very subject. He concentrated his mind entirely towards them. It was with impatience that he saw himself deflected from them by objections; his repose was disturbed, they were the only thing that could make him give up his ordinary mildness and benevolence; and we must confess that they sometimes produced that effect upon him. This disposition perhaps prevented him from paying sufficient attention to the observations made with Wollaston's new goniometer on the angles of calcareous spar, magnesian spar, and sparry iron. But who would not excuse a valetudinarian, long a stranger to the world, attacked at his first appearance in the most unjust and offensive manner; who would not excuse him, I say, for not having sufficiently distinguished from his first and ignorant antagonists, those who, afterwards enlightened by his own discoveries, appreciated differently from himself some facts of detail, or even some principles which he had too much generalized?

Certain it is, that in the moments when he paid this tribute to human weakness, he was only animated by what he supposed the interest of science; and that, if he vexed himself, it was only with what he thought would form an obstacle to the triumph of truth.

At the period when it was wished to give some activity to public instruction, the government requested M. Haüy to draw up a treatise on physics for the colleges. M. Haüy had more than one title to this commission, both in the ingenious manner in which he had applied physics to mineralogy, and in several interesting memoirs on the electricity and double refraction of minerals, as well as in the elegant exposition which he had given of Æginus's theory respecting electricity and magnetism, and in the success which he had obtained in the course of physics

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* Traité des Caracteres Physiques des Pierres Précieuses. 1 vol. 8vo. Paris, 1817.

which he gave at the Normal School created in 1795 by the Convention, and which only lasted a few months. But these titles were not sufficient in his eyes; he doubted especially whether he was permitted to give up, even for a short time, the researches to which it seemed to him that Providence had directed him; nor would he engage in business until he had consulted the Abbé Emery, the superior of Saint Sulpice. "Do not hesitate," said M. Emery to him, "you will be much to blame, if you lose this opportunity, in treating of nature, to speak of its author;.... and do not forget," he added, "to put on the frontispiece, your title of Canon of the Metropolis." M. Emery, who has not been less celebrated for his abilities, than for the purity of his sentiments, knew that there is no profession which may not be honoured by the talents of those who exercise it; and he remembered that the period when christianity made most conquests, and at which its ministers obtained most respect, was that in which they carried among the converted nations the light of letters, and in which they formed at once the most eminent and the most enlightened order.

If this treatise on physics did not add much to M. Haüy's scientific reputation, it did not injure his literary character. It was distinguished by the same clearness and purity of style as his Mineralogy, and was still more interesting than that work. It is one of the books best adapted to inspire in youth a taste for the natural sciences, and it may be read with pleasure by all ages. It has passed through three editions.

The author was keenly and repeatedly pressed to make known what he wished might be done for him. He merely asked that he might be put in a condition to bring his family near him, that they might take care of him in his old age and infirmities; and his desire was instantly gratified, by giving the husband of his niece a small situation in the finances.

Who would have imagined that a recompense so well merited should have disappeared at the first reform, and that M. Haüy's friends could obtain no other answer to their solicitations, than that there is no connection between the taxes and crystallography.

Newton was also recompensed by a situation in the finances, and a much more important one, for the glory which his genius had conferred upon his country; but he retained it under three kings and ten ministers. Why should the men who commonly for so short a time dispose the lot of others, sometimes forget that such acts on their part will remain in history much more surely than any of the ephemeral details of their administration?

This was not the only trial which M. Haüy had to undergo. Not long after, the laws of finance made him lose a pension when he was no longer capable of active exertion; and his brother, who had been taken to Russia to extend the knowledge of the means of instructing the blind, returned without realizing any of the promises that had been held out to him, and with a constitution so broken down that he fell entirely to the charge of his family.

In this manner did M. Haüy, towards the end of his days, see himself almost reduced to the extreme indigence which he had already experienced. He would have required all his religious resignation to support these reverses, had not his young friends taken care to conceal from him the embarrassments which his affairs occasioned them. Their attentions were in a manner doubled when he lost the means of manifesting his gratitude. The love of his pupils, and the esteem of all Europe, also contributed without doubt to console him. The enlightened men of all ranks who arrived at Paris, hastened to pay their respects to him; and, almost on the eve of his death, have we seen the heir of a great kingdom go repeatedly to converse at his bedside, and express his esteem for him in the most affecting terms. But the most substantial support which he found, arose from the thought, that, in the midst of his glory and good fortune, he had not renounced either the customs of his college, or those of his native village. He had never changed the hours of his meals, nor those of his rising and sleeping. Every day he took nearly the same exercise, walked in the same places, and on his walks he embraced all opportunities of exercising his benevolence: he conducted strangers whom he saw embarrassed, gave them tickets of admission to his collections; and many persons experienced these good offices at his hands, who never imagined of whom they received them. His old-fashioned clothing, his simple air, and his always excessively modest language, were not of a nature to make him be known. When he went to reside for some time in the small town which gave him birth, none of his old neighbours could have supposed, from his manners, that he had become a considerable personage in Paris. One day, while walking on the Boulevard, he fell in with two old soldiers who were going to fight; he informed himself of the cause of their quarrel, reconciled them; and, to assure himself that they would not cast out again, went with them to seal the peace, as soldiers are wont, to the gin-shop.

This great simplicity of manners would probably have prolonged his life, notwithstanding the extreme delicacy of his health, had not an accident accelerated his end. A fall which he received in his room broke the neck of his thigh-bone, and an abscess that formed in the joint rendered the disease incurable. During the long pains by which his death was preceded, he did not cease to manifest that benevolence, that pious submission to the decrees of Providence, that ardour for science, which characterized his life. His time was divided between prayer, the revisal of the new edition of his work, and his interest for the future lot of the pupils who had aided him in composing it.

M. Haüy died on the 3d June 1822, at the age of seventy-nine, leaving to his family the single but magnificent heritage of that precious collection of crystals of all varieties, which the gifts of almost all Europe for twenty years had carried to a degree of perfection which is unrivalled.

His successors were, in the Museum of Natural History, M. Brongniart; in the Faculty of Sciences, M. Beudant, and in this Academy, M. Cordier. These gentlemen are three of his pupils. In fact, and this will form the last circumstance which we have to adduce in his praise, it would be difficult to find, at the present day, in Europe, a mineralogist worthy of the name, who has not become so, if not directly, at least through an assiduous study of his works and discoveries.

# *On the most effective Employment of Steam-Power in general, and more particularly in Mercantile Navigation.* By Captain M<sup>c</sup>KONOCHIE, R. N. (Communicated by the Author.)

THE prevailing objection to the use of steam in mercantile navigation is its inordinate expence; and yet, in every other department of art in which a great force is wanted, the substitution of machinery for manual labour, and of a certain for an uncertain moving power, has been productive of economy, not of expence. This consideration, then, would seem to indicate, that there is some mistake in the usual mode of applying steam to the purposes of navigation, which causes this remarkable anomaly: and if we consider the matter farther, we shall, I think, discover another discrepancy, which goes far to solve the difficulty. In most other instances in which a great power is employed with a view to a given effect, the power is generated in one chamber, and applied in another, without the different sets of apparatus requisite for the production and application interfering with, or cumbering each other. In ordinary navigation, in particular, this prevails, for the sails in no degree, and the masts but a very little, interfere with the stowage of the vessel they propel. And in steam navigation alone (or only in common with the first and rudest method of maritime communication, that effected by oars), the horses are, as it were, received into the inside of the carriage, at once destroying *its* capacity, and exerting their own power to disadvantage. Both analogies, then, point one way,—both seem to me to conduct to steam-towing, as the only modification of steam-navigation which can be made generally available for mercantile purposes; and the further development of the subject is the purpose of this paper. On a former occasion I considered it as applicable to the maintenance of ferries *. I shall now, I. Describe the sort of vessels which I think best fitted to be connected together, and thus employed for general purposes. II. Detail some of the advantages which would seem peculiar to this mode of navigation. And, III. Having thus got a distinct view at once of the means contemplated as applicable to the occasion, and of the inducements to employ them, I shall review the difficulties in the way, and what appear to me to be the best methods of obviating them; in other words, give a brief theoretical sketch of what may be called the Tactics of Steam-towing.

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* Edin. New Phil. Journ. July 1828.

I. As a general principle, the steam-boat should not be large; on the contrary, it should, in every case, be as small as possible, consistently with perfect lightness and buoyancy under the weight of her machinery. It is not absolute, but disposable, power that is wanted in her; and it is easy to conceive, that a small actual power in a small boat may have even more of this than a great power in a large boat,—just as a light cutter, manned with six men, may pull faster to windward against a head sea, than a heavy launch or barge with sixteen. But there are other principles also to be attended to, some of them of the more importance (as appears to me), because, although applicable, in a degree, to all steam-boats, they are disregarded in the ordinary construction of them; and have, I think, been overlooked from not attending to the *rationale* on which the forms of sailing and rowing vessels have been, almost intuitively, modelled, and to the entirely different circumstances under which steam is applied as a propelling power.

Sailing vessels must have a good hold of the water to support them against their sails; they are, therefore, built sharp, and, as it is called, "long-legged," to acquire this. Their masts also are weak, compared to the power of wind to which they are occasionally exposed; and they are, accordingly, balanced on a central line, the keel, and the hulls of the vessels are rounded off on both sides from it, to facilitate their heeling to a strong blast, and thus increasing the support as it is required. And the amount of impelling force, both in sailing and rowing vessels, depends greatly on their length; and this dimension, accordingly, is of first importance to them, and in Admiral Chapman's expression for estimating their velocity $\left(\sqrt{\frac{B^{\frac{1}{2}} L^5}{D^3}}\right)$, it is the principal quantity; as in all vessels which carry goods, passengers, or a numerous crew, it is also that which furnishes the most accommodation. But steam-boats require very little hold of the water. So far from its ever being expedient that they should heel to the wind, the easy and effective working of their machinery essentially depends on their remaining always as much as possible upright. Whatever the power embarked in them, the impulse is confined to one spot; at least all attempts yet made to have even two sets of paddle-wheels along the length have failed, from the additional, and yet uncertain, velocity which the water acquires after passing the foremost wheel. And tug-boats, besides that they want chiefly strength of longitudinal fibre (if the expression may be allowed), which is in a considerable degree incompatible with inordinate length, scarcely require any accommodation unless for their engine; and if they can gain buoyancy without great length, are therefore, in every respect, better and handier without it.

Further, some inquiries have been lately made in America into the *prow of least resistance* for steam-boats; and the results seem to have been very interesting, although as yet we are only acquainted with two of them. The greatest velocity, fourteen miles an hour, was acquired by a boat "modelled nearly like the bowl of a spoon, with a very raking cutwater rising up in a uniform curve, and all the curves upon the bottom regular, and without abrupt angles." But "other forms had superior properties at lower velocities:" in other words, the prow of least resistance at a high velocity, was not that of least resistance at a low one. It were exceedingly to be wished that these inquiries were taken up in this country on a considerable scale; and perhaps the greatest contribution which could be made to steam-navigation, would be the keeping them in view at one of the government dock-yards, where every variety of form and circumstance could be in a short time commanded. In the mean time, however, it may be here observed, that it is not the *prow of least resistance* at a *high*, but at a *low* velocity, that is wanted for steam-towing; and that, in all probability, it will be found that the *solid of least displacement*, whatever almost its form, is that required. It is a light weight and draught of water, and a moderate pace, which are to give a large disposable power; and it may be remarked, that they will give great safety and economy too, both in like manner first-rate properties in a mercantile communication; and which is also just in the natural order of things, for one good result is generally accompanied by many more.

With these views, then, as guides, I would propose that steam-tugs should be short, in proportion broad, and perfectly flat vessels (or if it should be considered indispensable, for the sake of strength, that their bottoms should arch somewhat, it should be as little as possible). They should curve up at each extremity with a very raking shovel nose, fitted not so much to cut the water, as to glide easily over it,—with their sides rising upright from a sharp corner,—terminating sharp fore and aft,—lightly timbered, to obtain buoyancy, but strengthened by being, as it were, hooped in along the whole length; and clincher-planking would have these advantages, besides some others to be afterwards mentioned, it might be made above a half lighter with the same strength, and would not require caulking, an operation which in carvel-built steam-boats must be very frequently renewed, the heat and motion working out the pitch and oakum. The junction of the bottom and sides should be well secured, but as lightly as possible; wherever practicable, on account of the machinery, low water-tight partitions should be introduced, rising perhaps a foot above the line of flotation, which would confine any water which might flow in from an occasional leak within one small chamber; and along with these, a few light beams might be also laid, to support, together with the deck-beams, the top-sides against external pressure. One long beam, uninterrupted by hatchways, or, if they must occur, with its place supplied by very strong coamings, should in like manner extend between the stem and stern, or rather, as it may be said, between the two stems; for a very particular object would be, that a vessel of this description should go both ways indifferently. And outside, along the flat floor, two strong bilge-pieces, or rather half keels, should be securely fixed, partly to strengthen the frame length-wise, partly to support it against the lift of the engine, but chiefly to increase the stability, and also prevent lee-way when crossing a breeze of wind. They should, I think, be placed about two-thirds out from the keel, towards the sides.

Such a boat as this, whatever other qualities it might want or have, would be at least extraordinarily buoyant, and might be taken great liberties with, both as relates to the circumstances in which it is placed, and the weight embarked in it. Its machinery should (I think on the whole) consist of two engines, arranged so that one only, on an emergency, could work the paddles; although it is worthy of remark, that this security against accident would be purchased by other considerable sacrifices. Two engines are heavier, and more expensive, than *one* of their united power, and are nothing like so powerful, because the force of each merely concurs with the *momentum* of the other, insuring, but not very materially adding to its effect. Still, as a security against accident, two engines seem, at least in sea-going tugs, desirable *. The pressure may be either high or low; but whatever it is, there should be at least a great reserve of pressure against emergencies; and moderately high pressure, used expansively, is the most economical, and has the greatest range at its command. Whatever almost the power, it is desirable that the steam should rather be supplied by several small boilers than by one or two large, because small boilers can be made relatively stronger than large; where there are thus several, scarcely any accident could altogether disable the machinery; and there is some economy in small boilers,—in favourable circumstances, they need not all be used together,—the greatest available quantity of heat, according to Mr Dalton, is derivable from a fire not exceeding fourteen inches depth,—and the shallower the water above the fire, the more readily does the heat penetrate, and drive it off into steam. For the purpose of going both ways indifferently, the paddle-wheels and axle should be placed exactly in the middle, between stem and stern; and the more equally the rest of the machinery is distributed along the floor, leaving the extremities light, the easier the vessel will be. Perhaps one of the greatest defects of the ordinary steam-boats in a sea-way is, that the whole is huddled up in the least possible space, and generally far forward, for the sake of accommodation.

It will not be necessary to enter into the same detail with respect to the vessel to be towed; for the truth is, that, although better could easily be devised, and, if the system gains ground, will certainly be employed, the hull of any ordinary small merchant vessel would do to begin with. Her size must be regulated by the power of her tug;—but it is very important to observe, that it is certain it may be what may appear at first sight very large, relatively to that power. Without masts, and towed, as I think it ought to be, close up in the smooth wake, and under the lee of the tug, even under the most unfavourable circumstances a vessel of this description will tow light. In America it was on one occasion ascertained, that to give a vessel a certain velocity, one-third only of the power is required if that power is applied from without, to what is necessary if it is embarked in the vessel herself. At the mouth of the Tyne, where steam-towing prevails to a great extent, steam-boats down to three-horse powers take charge of colliers in light weather, and tow them out to sea over Shields' bar; while the highest average power employed is about thirty-six horses, and this takes them out against any weather, with their masts and yards up, and heavily laden. And every seaman who has had occasion to send his boats ahead to tow in a calm, must have been astonished at the effect he thus produced, if he ever considered the unfavourable line of traction, generally from the bowsprit end and consequently deviating greatly from the horizontal,—the petty lever, a few boats' oars, employed,—and the certain nullity of the same power, had he used it on board. There can be no doubt, then, that a very small power, relatively, will here produce a great effect *, particularly if other circumstances are kept favourable too. The vessel towed should also be flat, and studiously modelled to tow light,—in particular perhaps, lightly timbered, with her extreme breadth well forward, tapering off towards the stern in a straight line, and sitting at least on an even keel, or rather a little by the head,—this being the sit of a mast with its large end foremost, in which way it is found to tow lightest. That the greatest capacity may be joined to the smallest size, her hold should be kept entirely clear for cargo, the crew and passengers being accommodated on deck; and on the poop and forecastle thus erected, and further supported by a narrow platform between them, the requisite spars and rigging to enable jury-masts to be stepped, and a little sail made on occasions, might be stowed away. Two extra half keels, the same as on the tug, will at once give her stability on these occasions, keep her to windward, and prevent rolling; like the vessel herself, they should taper off towards the stern, and, if constructed to slide up and down, according to circumstances, on Admiral Schank's plan, there would be an advantage. The mode of connecting the two vessels will be best detailed subsequently under the head of Tactics. In the mean time, supposing all difficulties of that kind can be overcome, provided there is sufficient motive to induce us to make the attempt, let us now inquire what is then the motive, and to what extent this would seem to be an improvement on the current means, especially of mercantile communication.

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* It has been suggested to me, since the above was written, that two engines could be embarked and used separately, or only together on particular occasions; and that thus the security contemplated above could be gained without habitual loss of power. There seems to be one rather strong objection to this plan, viz. that it does not give the same certainty of effect when working, as two engines fitted in the usual way,—one engine being liable, if it does not work very well, to hang on its centre, and perhaps return, instead of going round; and high pressure engines, worked expansively, are peculiarly liable to this, their power being nearly quite exhausted towards the termination of their stroke. Still the idea may deserve consideration, and would certainly give a considerable saving, and much greater range of power to be used as circumstances might direct. The weight would not either be greater than that of two engines on the usual plan.

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* This is another portion of the subject, at the same time, on which a few well arranged experiments on a great scale would be very desirable. The particular result alluded to above as obtained by the Americans, was, "that to give a vessel ascending the Mississippi an absolute velocity equal to one-half the current of that river," (which by other experiments was found the most effective pace), "three times the power was required if embarked on board of her, to what was necessary when employed on shore tracking her." But the general questions would be, How far is this advantage maintained, lost, or increased, when the tugging force is also afloat? Does it differ materially at different rates of velocity, or in different states of weather, or when the power and the weight to be transported are otherwise in different proportions? If so, what are the most advantageous rates and proportions for towing, and carrying? &c.

II. 1. Wherever great speed is required, this plan does not seem advantageous; because it is impossible to conceive that, under any circumstances, a steam-boat should be able to tow another vessel, of equal or superior size to herself, as fast as she could go, were she altogether unincumbered. It is particularly to be observed, however, that great speed is in every case incompatible with minute economy, and is therefore never a first object in mercantile communication. The most effective pace of a horse is about five miles an hour, and within this accordingly (considerably within it if heavily laden) carts and waggons are chiefly limited. Merchant vessels are not in general constructed with even the regard to speed which is requisite for safety. And in steam navigation, the expence at which alone speed can be purchased is very striking indeed, it having been found that, if a power of twenty horses gives four miles an hour, it will require one of eighty horses to double this rate, of a hundred and eighty to treble it, and scarcely any power whatever will materially exceed this limit. Under no circumstances, therefore, and by no means, is it probable that a very quick transit of heavy goods can be given, consistently with the economy which, at the present moment especially, seems indispensable in mercantile transactions.

2. A very good average speed, however, four, five, or six knots an hour, for example, as may be found on trial to give the most beneficial effect, may certainly be commanded in this way; and, to this, the peculiar build proposed to be given to the vessels employed, will in no small degree contribute. The form is not the best for extreme speed, the result of the experiments already alluded to in America giving another shape for that purpose; but that, at a moderate pace, which shall give the water impinged on time to disperse, mere form is comparatively unimportant, and weight and draught of water are almost the sole considerations, many facts lead us strongly to infer. A square plank is more easily impelled lying flat on the water, than when made to swim edge-wise. The least impulse in the world will move a skimming dish. And light merchant vessels all sail nearly alike, and all moderately well, right before the wind; and steam-power is always a fair wind.

3. A good moderate pace being then certain, it is next to be observed, that it will not be much affected, upon this plan, by adverse circumstances; and that incomparably greater punctuality will be thus attained in the transmission of goods, than is at present possessed. The power here proposed to be employed is variable, according to circumstances. As just remarked, it is always fair; the vessels in which it is embarked are peculiarly buoyant; the uniform distribution of the dead weight on board of them will make them easy in a sea; and the craft astern, being without masts, or long lever of any kind, by which wind can be held, and being close up under the lee of their tugs, and in their smooth wake, the task of towing them can never be excessive. At all events, the uncertainty which may thus still remain, can be as nothing compared to that under which goods are shipped in ordinary traders; and in a credit trade particularly, punctuality in the delivery of consignments on the faith of which bills are immediately drawn, must be a first consideration.

4. There would also be great safety in this mode of transit, compared with what is afforded by merchant vessels of the usual construction, the smaller classes of which, indeed, are in this country, from a variety of causes, the

most unsafe vessels, perhaps in the world, for the service required from them, as witness the wholesale loss of them experienced every winter. And steam-boats, as now built, are also eminently unsafe, not the slightest provision being made in them against the inevitable consequences of any considerable leak. As here proposed, however, scarcely any accident could possibly carry them down. With two engines, and a number of boilers, their machinery could hardly ever be entirely stopped; and if it were by rare accident, both vessels could make a little sail, or anchor, according to circumstances. If the wind, during a voyage, came to blow on a neighbouring shore, a slight deviation from the direct course would soon gain an offing. If a heavy sea got up, the head could be laid, for a few hours, in any way that suited best. The light draught of both vessels would, as it were, blot out of the chart a variety of dangers, which are only formidable where much water is drawn. This, together with the complete command of manœuvre, would make even the most intricate passages easy. At the very worst, good ground tackle would hold vessels of this description for ever; or they would come to their jury masts, with their courage and resources entire, neither wreck to cut away, nor other confusion to contend with. And to crown all, more care would probably be taken in selecting masters for these valuable tugs, on whom the navigation would entirely devolve, than is notoriously taken in trading vessels, or than can be afforded by the profits yielded by the smaller classes of them. Were the whole system indeed methodized, as I think it may and will yet be, and tugs belonged to one set of proprietors, and the vessels which they towed to another, and the former were hired as required, and gradually came to ply chiefly to certain ports, and along certain coasts, this last consideration would, I think, be even paramount in recommending the plan: For the masters of these tugs would just be first rate pilots, whose individual property, character, and bread, would all be dependent on their intelligence and attention.

5. There is another advantage attending the light draught of water here contemplated for merchant vessels (and which could scarcely ever exceed four or five feet), which is of extreme importance. It would open up to the purposes of commerce many harbours which are now shut; and in others, be a virtual carrying out of deep water piers, where the actually doing so, under existing circumstances, is impossible. It would also extend the benefit of junction canals, which are all fully shallow, to a much greater number of vessels than now derive any benefit from them; and at the same time encourage similar works where the requisite supply of water for deep cuts cannot be procured, but where shallow trenches might thus be equally useful. And there is one point of view in which this anticipation would seem peculiarly interesting. Local improvements, whatever their extent, are necessarily of a temporary nature, and must be upheld at a constant, and in time growing expence, or be at some period again lost. But an improvement in the build of vessels generally, as here contemplated, would be a permanent acquisition,—of the more importance, that, in fact, the opening up a sea-port, where before there was none, can scarcely be too highly appreciated as a benefit to those concerned. It is a moral as well as a pecuniary gain; and stimulates the energies of the whole adjoining district, enlarging the scope of industry of its

inhabitants, exercising their faculties, and opening up prospects to them which at once give them earnestness and steadiness of industrious application.

6. The expence of building and fitting out a merchantman, to be thus towed from port to port, would be greatly less than when she has to be fitted with masts and sails, and strengthened to support their weight and conflict with a heavy sea. And her capacity would be greater, because her hold would be clear fore and aft, instead of being, as now, interrupted by cabins and other accommodation, merely for the crew. She would thus at once cost less, and carry more; and even if the expence of actually moving her were to be greater, she could better pay it.

7. But the expence of moving her would be less also, at least on an average of voyages, for there would be no loss of time arising from contrary winds, and even a snail's pace would produce a quicker return. And this will be best proved by exhibiting the expences incurred under existing circumstances, as they may be gathered from the current freights charged by sailing vessels, which at the same time are said to be at present unusually low. From Leith to London, the average freight I find to be 23s. per ton; to Newcastle, it is 20s.; to Liverpool, from 35s. to 50s. according to the admeasurement of the article embarked; to Dundee, 15s.; to Banff, 24s.; to Hamburgh, from 25s. to 30s.; to Peterhead, 18s.; to Perth, 16s.; to Aberdeen, 16s.—the whole averaging (at least on these short voyages) above 9s. per ton, or L. 45 per 100 tons, for every 100 miles of distance made good;—a run which, at the easy rate of four miles an hour, a steam-tug would accomplish in a day, at an expence not exceeding from L. 5 to L. 10 even now, and which will certainly be greatly less, when economy shall come to be minutely studied in the production and application of steam to nautical purposes,—in other words, when steam-boats shall become really useful in trade. As yet, they may be said to have been rather the toys of the rich, than the bread-winners of the poor man;—or, when this has not been the case, the locality has been some great coal district, where a saving of fuel has been no object. Velocity of movement, and splendour of decoration, have been the chief objects studied in them; and there is little doubt that this want of *useful* direction in the minds of their improvers, has contributed greatly to limit their employment.

8. An important step, however, towards a change in these circumstances, would be gained by the mere entering on this tug plan, keeping in view, at the same time, the whole details here connected with it. Steam-boats would be thus smaller,—a smaller scantling of timber, even in proportion, would be required for them,—all temptation to indulge in useless finery would be taken away,—they would thus be more cheaply *built*; and, even though their wear and tear continued the same, it would be more easily supported, for, when the investment is smaller, it is sooner made up, and can be more easily renewed. But small boats lightly timbered and clincher planked, would be found, I am persuaded, to have another advantage over those of the present large and heavy carvel construction,—they would suffer less from use and repair, and thus probably last longer also. The heat of the fire inside of a steam-boat, dries up the natural juices of the wood, which even the longest seasoning will not altogether expel. The water penetrates, and supplies

their place; the more wood there is in the frame, the more it suffers from being thus water-logged, and the more the vessel sinks below its original draught line,—the larger she is, the more she will labour in consequence, and the more she will rack and strain her principal timbers; and if of a construction to require caulking (that is to say, if carvel built), every time that operation is renewed,—and it must be very frequently,—the wider will her seams become, and the more she will depend for her safety on a little pitch and oakum, on which, at the same time, the fire and motion will immediately again act. I am assured that the present average duration of steam-boats is only twelve years; and there is little doubt that much of this rapid consumption is owing to the undue weight of wood employed in them. And, if the material could be changed altogether, and iron substituted (of which there are, perhaps, some hopes *), the improvement would be very great. But, at all events, smaller boats, clincher-built, would be some gain. And, if they were fitted, moreover, with a light inside lining, a few inches from the side, which would thus inclose a body of air to a certain extent stagnant, this would operate as a palliative, as containing a non-conductor. And boats of the construction here proposed would be particularly suited to receive this, from their great breadth, and flat regular form.

9. Steam-boats would thus also be a greatly more convertible property than now, when, if they fail in paying on the particular service for which they are built, they become a dead stock, too long, or too weak, too large, or too small, or drawing too much water, for any other purpose at the moment in the market, and thus incapable of being disposed of without a great sacrifice. As thus proposed to be constructed they would all be strong, partly from the peculiar arrangement of the materials which is favourable to strength, partly merely because they would be shorter, great length in all vessels, but especially in steam-boats, occasioning weakness. They would likewise all draw little water, nearly alike, and all be fitted, according to the measure of their disposable power, for every possible service. And they would thus maintain their value, like other vessels, in the market.

And, lastly, when steam-boats shall be thus more cheaply built and maintained (and in this last particular also, I am persuaded that immense improvement may be made, both as regards the production and application of the steam †),—when they shall be more certainly saleable than now,—when they

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* Iron-vessels, besides being more durable for a particular service like that of steam, are cheaper and more buoyant; and the difficulty is not how to make them strong enough to go to sea, but how to protect them against the action of the salt water. The hopes now entertained are of obtaining a resin, yielding a simple, not a compound varnish, of sufficient body not to be affected by any heat proceeding from the fire, at the same time so elastic as that it shall not crack with the motion of the vessel, and impenetrable by water.

† In districts where fuel is scarce and dear, a saving is made by mixing up clay and other ingredients with the coals used; and it has been said that some experiments of this kind, lately made in London, in steam-furnaces, have been very successful. Certain forms of boilers lately patented, promise also a large economy in the quantity of fuel used. Improved paddles will probably do something: systematic abatement of speed, in all cases which will not admit of a liberal expence, more; and much would be also gained by a great range of power, both up and down, so that as expence is incurred in unfavourable circumstances, a corresponding saving may be made when they are favourable. (And it is in this last point of view that two engines to be used alternately or together, as required, a number of small boilers instead of two large, and high pressure steam worked expansively, appear to me so peculiarly eligible in navigation, in which the resistance to be overcome varies

shall be also safe vessels, and not liable to go down, with every little hole in their bottom,—when they shall be properly sized, according to the power of their machinery, and the very smallest power consequently be valuable, and appreciated accordingly,—when the pursuit of useless ornament shall be abandoned, and the investment of capital in them become thus altogether reasonably moderate, profitable, and secure;—when all these changes shall have taken place, and the introduction of steam-towing into general navigation seems the certain road to them, we shall then have more of these vessels, they will get into the hands of those who must either work them or want, and they will gradually come to be applied to a variety of cases, and in a variety of ways and circumstances as yet unthought of. A steam-boat is just a rowing-boat, with a much greater power of oars,—in facility of manœuvre, and certainty and precision of effect, it is beyond comparison superior to a sailing-boat,—it is, or ought to be, nearly indifferent to wind or weather, and, in fact, it is just in the most difficult circumstances, by night or by day, that it is desirable to have one at command, and be able to avail ourselves of its extraordinary powers. Yet at present there are scarcely any afloat, unless with their specific employment, from which they cannot be diverted: in difficult circumstances they are universally laid aside; to say the truth, when their extravagant value, varying for the most part from £3000 up to £40,000, and their fragility, as at present constructed, are considered, it will appear only natural that they should be thus charily employed; and yet it is difficult to say what extent of advantage might be obtained, were these circumstances reversed. I shall mention two cases in particular, because they appear to me full of interest and importance in a great many views. But others will readily occur to those familiar with nautical work.

No use has yet been made of steam in relieving the more critical cases of shipwreck, and yet these are just the occasions in which the ready command of such a power would be most eminently useful,—or rather, when it would be interesting in a much higher degree than can be classed under the head of mere utility. Life-boats can only save life; being impelled by manual labour alone, they are not always available even for that; in particular, they can scarcely ever put to sea, and come down on a vessel lying in a surf, although she may be altogether inapproachable on the land-side. Sailing-vessels can still less venture on any such manœuvre. Steam-boats, as usually constructed, are too weak, too costly, and have too little relative power, to be willingly placed in difficult circumstances of any kind; and however strongly we may be impressed by these considerations, it would appear impossible to have any constructed and kept for these occasions alone,—the tax would be too heavy which would be thus imposed on the humanity of a district. Were steam-towing, however, to become generally prevalent, it would just be a harvest for these tugs to look out for wrecks, and adventure in their relief. Expressly constructed to meet difficult circumstances, they would not hesitate to place themselves in them. In almost the worst, they could venture

from hour to hour.) Lastly, in some experiments lately made in Cornwall, the effective power of an engine was raised from fifty to above eighty millions of pounds, lifted in a given time, merely by inclosing the steam-pipe in a non-conductor (sawdust), and thus maintaining the steam throughout at its original pressure. In most steam-boats this pipe passes along close by the hatchway, frequently double, it is true, but still by no means protected, as it easily might be.

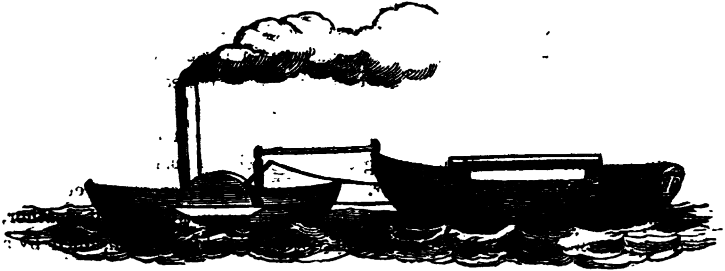
near enough to veer in a boat or raft to save life; and in others they could either lay out anchors, or if the water was too deep, be themselves harnessed to a wreck, and bring it off, when no other force could possibly be applied to it.

Again, it is not probable that a large steam-engine can ever be embarked to advantage in a man-of-war. Steam-frigates have been successively tried in America, in England for the service of Greece, and more recently in France: they have uniformly failed, even for holiday work: when the extreme danger of opening a magazine on board of them, while a blazing fire is under their boilers, and the chance of their being disabled by a single random shot, are further considered, there seems to be no inducement to repeat the experiment; and even the large steam-boats which have been of late years kept at our dock-yards, and occasionally also sent on detached services, are but of limited utility,—most convenient when they can be applied, but expensive, and, from the quantity of fuel which they require, scarcely to be kept at all, unless on the home stations. If, however, the value of even the lowest powers, suitably embarked, were duly appreciated, and, in addition to these, if every ship was supplied, as a part of her furniture, with a two, three, four, six, or eight horse-power engine, according to her rate, and with a light clever flat fitted to receive it when required, an immense step would be gained in the application of steam to naval purposes. In a calm, these engines, even alone, would be found of the greatest service to their respective ships; and they could be worked night and day, without fatigue to the crews, who at present are knocked up altogether, whatever the emergency, by a few hours' towing. They would thus give an advantage to large ships possessed of them, over the small craft usually employed in privateering, piracy, and smuggling, which would go far of itself to put these down. In a fleet, two or three together would do almost any thing which a powerful tug could do, without the embarrassment of having to study such a vessel in blowing weather, so as to keep company with her. On blockade service, they would better enable a squadron to resist a steam force sent against it in light weather, than one or two large boats, and would not be so liable to be disabled by a few random shot. And in watering and provisioning ships, in laying out anchors when a-shore; or, were the same system applied to large merchantmen, in towing the ship, or bringing off cargoes, their powers of draught would be invaluable, and would frequently save life, as well as property and fatigue,—this sort of boat-service being of all others that which injures ships' companies most, in unhealthy climates almost invariably bringing fever amongst them.

III. These, then, are some of the advantages direct and contingent to be derived from the system proposed, and it only remains to consider the principal difficulties in its way. They certainly do not appear to me considerable; and as I write, my views on the subject are in part borne out by the circumstance of a large West Indiaman being picked up in a gale of wind dismasted, and towed into Cork by a passing steam-boat. The question, as it appears to me, suffers by some little apparent resemblance between *steam*-towing, and one of the most awkward and embarrassing of all nautical operations.

towing with an uncertain moving power, wind, over which we have no control, with a quantity of yards and masts aloft, frail in nearly the same proportion that they are precious, and which, therefore, greatly increase the danger to be apprehended from occasional collision, and with, after all, only a limited power of manœuvre by their means. But steam-towing is really scarcely more like this than a wheel-carriage drawn by horses is like one also impelled by sails. And on the contrary, a power which can be made any thing in amount that we chuse to have it, which can be urged, slowed, stopped, and reversed at will, embarked in a boat which can go either way indifferently, and in all cases leaves a broad, smooth wake behind it, seems to me even better than a horse,—it can do more, and is more docile;—and only requires that the shafts, by which it is harnessed, shall be moderately well contrived.

My own contrivances, then, for this purpose, I shall now detail, although I am very far from feeling confident that they are the best possible; and on the contrary, am well persuaded that a little practice will improve them greatly where deficient, and probably prove some of them even supererogatory, as anticipating difficulties which will not be found to exist. Still something will be gained, if professional men are thus induced to consider the subject closely, even though the result be their dissent. I shall state my views in order, as they regard towing, steering, conduct in a gale of wind, and making sail in case of occasional separation, or the disabling of the tug.



1. I have already said, that I think the vessels should be kept close together, even to an excess in most cases, making them almost as one vessel, with a flexible backbone; my reason for which is, that immediately astern of the tug a peculiarly smooth track will be always found, a sort of cradle, in which the vessel astern will meet little or no opposition. Although thus closely united however, some means should be provided to prevent actual collision; and I propose the simplest possible, viz. hanging a spar between the two vessels (in the tug hung well forward, that her head may not be thrown out when backing); which spar, when towing on end, should hang free and loose, but when the vessels approach will tighten more or less gradually, according to its weight, and act in all respects like the pole of a carriage, slowing or backing, when required. Two towing hawsers should be employed, led outside from about the chestrees of the vessel astern, and each in two parts connected by a hook or otherwise inside the tug, for the facility of slipping when

required; and they should be taken also to nearly the middle of the tug, partly that the advantages to be derived, in certain circumstances, from a longish scope, may be thus retained without increasing the distance between the vessels, and partly that both may be left free to pitch. The neglect of which last slight precaution, in ordinary towing, seems to me, indeed, one cause of the prejudice against it; for, if the vessel astern is held by the nose, and dragged rapidly through the water, it is obvious that this latter must rise and ultimately break on board, an effect familiarly called "towing under water," but which would not follow, were the bows free to rise also. It is true that it need never happen, at all events, in steam-towing, in which a moderate pace can be always preserved; but the necessity of moderating the pace, on this account, would be indefinitely postponed by towing as suggested.

2. The act of steering should, I think, in most cases be confined to the tug; and although the vessel astern should of course have a rudder hung, to be used in case of separation, when attached to her tug I do not think it need be touched (unless on particular occasions in rapid tide-ways),—breaking sheer, yawing, &c. being rather the concomitants of a single long tow-rope, than of two short hawsers, in which a vessel would be held as in slings. To facilitate steering in the tug, the hawsers might, in her, be led to a yard turning freely round a short iron-mast, stepped either before or abaft the midships of the vessel, according as she shall be steered aft or forward; which last condition, however, will require a few words of explanation.

It will always be convenient that a tug, about to take a vessel in tow, should not be embarrassed by the necessity of turning, but should be able, by merely reversing her engine, to come out as she went in; and in approaching a wreck on a lee-shore, this will be even indispensable, as the attempt to turn among breakers would be sheer madness. And the most obvious method of providing for this is to hang two rudders; but I am very doubtful how far it would be the best. A tug, particularly if without specific destination, and in the market for a job, must frequently have occasion to move about alone; and, on such occasions, precision of steering will be of extreme importance to her; in fact, it is the quality on which, of all others, the handiness with which she will take any vessel in tow will most essentially depend. This precision would, however, I should fear, be considerably affected by a deep gripe forward, ready to be caught by every passing wave; and on some other scores also, she would unquestionably be better without it.

When actually towing, however, there does not appear to me to be the same objection to it; for the weight of the drag would then, I think, effectually counteract any power in the gripe to throw the head off, unless further assisted by the rudder; and altogether, the advantages which would seem thus attainable, appear worthy of particular consideration. The utmost precision, as already hinted, would be given to the tug's steering, when going down on a vessel which she is about to tow; when harnessed, the gripe forward would assist the action of the rudder, and steady the head against the jerking of the drag astern; the steersman would see better what he was about forward than aft; in shallow water, when steam-boats of the usual construction steer especially slack in consequence of the disturbance made by their paddles in the water passing to the rudder, these would remain entirely under command; and although, when towing, accidental separation should be impossible while there is room along the whole length of the two vessels for preventer hawsers, still, in such an extraordinary case, or, in the event of a man falling overboard, or any other contingency which may make it desirable to slip at short notice, the tug would thus be especially ready to dart astern.

These views, then, appear to me plausible; and they are fortified by the fact, that, in some late experiments on the Forth and Clyde Canal, this mode of steering was found to answer perfectly, and have indeed singular power. But they are not thus altogether confirmed notwithstanding; in a sea-way, for example, a rudder forward may be too much exposed. I do not think, however, that this would necessarily be the case. Upon this plan, it might be made much smaller, and be more strongly secured; or it might be differently hung, in a way which appears to me calculated to obviate the difficulty altogether;—in a word, all this remains to be seen. In the mean time, suffice it to add, that if the rudder is aft, the tow lines should lead from before the midships of the tug,—if forward, from abaft them,—in both cases, to lengthen the lever with which the helm acts[*]. And, in a steam-boat, its power can be always reinforced by a moveable weight on deck; which, by raising or sinking one or other paddle-wheel in the water, can so increase or diminish its force, that a small steam-boat can be thus brought round, almost on its heel.

3. In a gale of wind, it may sometimes be desirable to increase somewhat the distance between the vessels; but never, I think, very much; because the intervening pole and steady headway of the tug would always prevent actual collision; and the *momentum* with which the vessel astern would 'scend aft, not being reinforced by the weight of masts, nor by the wind they hold, she would always tow comparatively easy, and a long scope would never be required. In a very heavy sea, it would be a relief to lay the head in the easiest direction, and lay to, as it were, for a few hours, keeping steerage way on, and not much more. When bearing up before a very heavy wind and sea, it would appear proper to slip the intervening pole, and have a good scope of hawser in hand before commencing the operation; then get the steam-boat well off, and with good way on her, before beginning to tug; and in a very extreme case, a jurymast up, and square sail, ready to shew, as soon as it will draw, in the vessel astern, would make her more lively and alert in falling off. It would be an annoying task to tow with a heavy beam-sea, which would occasion rolling, whatever the form of vessel employed:—but in such cases, a small deviation from the course will give relief; and other similar resources will always suggest themselves on occasion. In anchoring on a lee-shore, the paddles kept gently going would ease the cables; and if, on the other hand, the danger from drifting was not great, but the steam-boat rode uneasily, exposed to a heavy sea, she might be brought under the lee of the other vessel, and there secured. In all cases there would be much comfort and safety in the two hulls, and the double

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[*] In the annexed wood-cut, the towing-mast is placed as though the tug were steering forward, my opinion leaning to that method. But I have not shown a rudder at either extremity, meaning thus to leave the point open. When steering aft, the tow-lines should come from where the funnel is in the cut.

chance which they would afford:—and no comparison, I should think, in both points of view, between this and the ordinary steam-boat conveyance.

4. The great object in contriving the jury-masts, would be to unite the greatest possible length and strength with the lightest weight, and the utmost facility in getting them up and down. For these purposes the masts might be hollow; the platform on which they are usually stowed, might consist of two or three longitudinal beams, like partners, between which, when being stepped, they would rise easily and safely, whatever sea were running; and to facilitate the operation still more, the step on deck might move on a swivel, and the heel be entered before beginning to raise the head. The rigging should be as light as possible, not, perhaps, exceeding two runner-tackles and a stay: and the sails should be square for running, and three cornered stay-sails, for laying to. Two or three of each, with good ground-tackle, in case of approaching the land, would furnish the necessary shift for almost any emergency; and much more than is usually possessed by dismasted merchantmen.

Here, then, for the present, I close these speculations; and I cannot help thinking the subject very important, whatever may be thought of some of the conclusions at which I have arrived respecting it. There can be no question that the present application of steam to navigation is at once unsafe and expensive, as regards the construction of the vessels;—that the power employed is high, the effect small;—that effect further limited to certain lucrative and safe branches of trade, its pastimes rather than its tasks;—and some improvement in these respects, some way by which a more extended benefit may be derived from this wondrous power, is obviously desirable. On the other hand, something would be gained by a mere improvement in the build of steam-vessels, making them smaller, lighter, more compact, deriving strength from the disposition rather than from the mass of their materials, thus at once safer and more powerful; and, by a due appreciation in working them, of the superiority of these properties, together with minute economy, over mere speed and decoration. But, besides this, the principle of traction seems given to man expressly for the conveyance of heavy burdens; its advantages are universally recognised and acted on in land communication; in locomotive engines, in particular, the effect thus produced appears really almost miraculous, when it is considered that the only *fulcrum* is the friction arising from the weight of some ten or twelve tons, iron upon iron, whereas marine tugs have an actual hold of the water by means of their paddles, in addition to the friction arising from their weight; already, in consequence, the same great principle is applied, in maritime communications, to certain exigencies arising from distress, or from required precision of time or manœuvre, as on arriving at, or leaving a port; and its more general and systematic employment does not seem beset by any insuperable difficulties. And if these difficulties *can* be overcome, the promise is not only very great, but singularly opportune,—economy, when trading and shipping interests both languish for want of return,—a certain and solid advantage, founded on our superior command of machinery and fuel, when foreign competition is most severe,—and security, punctuality, and dispatch, when a great credit trade especially requires such supports. The plan has also another advantage (in common, it may be added, with most really useful novelties), it may be gradually introduced, and is susceptible afterwards of indefinite modification and extent. Were a couple of tugs, for example, started on the Forth, they could give every little port along its shores its weekly, or more frequent communication with Leith or Grangemouth, or both, as its affairs required,—giving thus the adjoining districts the same accommodation *daily*, for the points of traffic would soon be known for every day in the week,—and carrying home to every little corner which could defray the expence of a decked launch, and the occasional hire of the tug's services, the healthful stimulus consequent on a little trade. And the same thing could be easily done on every navigable river in the kingdom. The system might next be applied to the transport of cattle from the North Highlands to southern markets,—or to any other such short coasting traffic, as, by a little care and attention, could avoid the most unfavourable circumstances, till confidence had grown to meet them too. And last would come longer voyages also, for when certain fair winds, with their concomitant advantages, were thus in the market for hire, it would not be a few hundred miles, more or less, which would scare from their employment. The just limit would come of itself, and would, in all cases, depend on the importance of punctuality,—on the nature of the navigation, which when close and winding, as from this country to the Baltic, is more assisted by a complete command of the impelling power, than when the course is across an open sea, where almost every wind gives a long leg,—and also on the length of the voyage, for in a long sailing voyage the balance of chances is in favour of a vessel's progress, from the greater number of points of the compass which give a fair rather than a foul wind,—and moreover, the speed with which sails will impel in favourable circumstances, so nearly makes up for what may be lost when they are unfavourable, that not much is gained by the use of steam-power. The Enterprize, for example, was, I believe, even longer in her passage to India than many sailing vessels. But even here the system is not without its application; and if vessels, bound to hot and unhealthy climates, where calms are frequent and boat-service severe (and most very long voyages are of this description), if such vessels would adopt the plan recommended above especially for men of war, and embark each its own light flat and engine, the benefit that would be derived from them, would, I am persuaded, be prodigious. In dispatch, security, and command of a great towing-power without fatigue, on either dangerous or otherwise urgent occasions, their expence would be repaid almost in the first voyage. And, as ships outward-bound are generally light (manufactured goods occupying less space for their value than raw produce), the necessary supply of fuel would not be in the way.

And it may be worthy, perhaps, of particular remark at the same time, that although the more complete form of this system is thus considered, as chiefly applicable to coasting, or other short voyage trading, it is by no means understood that it should be confined to our own coasts:—on the contrary, it seems to me to open up very extensive prospects of advantage, even at this moment, in the Southern Hemisphere. In the West India, and other long established traffics, it is uniformly the case that the distant trade is confined to one or two principal ports, which communicate again with the others by coasting vessels. In the East India Free Trade, the same custom is creeping in, many mercantile houses keeping small brigs constantly in the country *draguingi*, that is, collecting freights for their large ships, which themselves only go to the head ports. And there can be no doubt that this practice is most beneficial, and will spread,—though it would be greatly facilitated by the introduction of a well organized system of steam-towing, for which a tropical locality is also peculiarly fitted, from the frequent calms, currents, long prevailing winds in one direction, lee-shores, and small number of ports along certain coasts, by which it is distinguished. In these circumstances, large ships, coming from a distance, go about collecting freights for themselves at peculiar disadvantage,—but they never do such a thing well. They incur by it a great loss of time, and, by consequence, great expence; they encounter many unnecessary dangers; their masters can seldom be acquainted with the native merchants; they are apt to despise small consignments; and their stay in the country being uncertain, being scarcely ever bound directly home from any place, they do not really suit the individuals who would otherwise be glad to employ them. Were steam-tugs, however, constantly cruizing about, ready to take each man's own little bark to some great port, where many ships would be constantly loading direct for Europe, and where cargoes could be immediately consigned to them, an extraordinary stimulus would be given to the home-trade; and that out would equally benefit, for these little barks would load return-cargoes on their own account, and as suited themselves,—every description of export would thus find its best market without risk of mistake,—every petty native trader would be a British agent; and the system might thus subserve political purposes also of no trifling value. A very small impost on the great transit trade which would soon spring up at these principal ports, would yield a great revenue. Were they further declared free ports, it might be the price at which such a concession was made; and the tribute paid would be from foreign as well as domestic trade, and conceded, not grudgingly to our power, but willingly to our capital, machinery, and the use we should thus make of these advantages. These ports would accordingly be sources of influence in our hands such as no military force could equal, eliciting the resources, stimulating the energies, and engaging the affections of those who corresponded with them, whatever almost the political state of these latter, their local or moral disadvantages, or their ignorance of the higher arts of commerce or navigation. And the operation of the system would be throughout liberal, beneficent, and pacific, without difficulty or sacrifice of any kind, even from the commencement. For outward-bound ships could easily fill up with coal (they already dunnage with it),—a large supply could, I believe, also be procured from New South Wales; modes would be devised of reducing its expenditure, by consuming wood and other substitutes along with it; and, at all events, the speed and punctuality with which communications would be thus everywhere maintained, would bear a heavy expence, with still a great advantage.

This is not the system, only one application of it; and may therefore be approved of or not, whatever may be thought of the main question. But thus far such remarks appear strictly in point. The object is to recommend experiments in steam-towing; and every portion of the reward (or supposed such), which may be reaped from success in it, is a legitimate argument in favour of a first attempt. And one more may be extracted even from the variety of topics which have thus naturally, and without violence, found here a place. Steam, as at present employed afloat, can scarcely be said to be available in more than one description of work,—packet service. It is here contemplated as applicable to many. And it may be very confidently maintained, that it is the extent of application of a new principle, not the importance of any one exhibition of it, which constitutes its real value, and may be said to be its measure *.

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* Since the text of this paper was printed, I have met with a table, published by Mr Tredgold, which places the extravagant expence incurred by the passion for speed in steam-boats in a still more striking point of view than I had before seen it. According to this authority, the power necessary to give a boat different velocities is as follows; and it would be very interesting if the table had other two columns, one shewing the first investment, the other the daily expenditure (on an average) against each number. We should then still more distinctly see the price paid, under existing circumstances, for mere speed, but which is generally considered inseparable from every use of steam-power.

| | | | | | |
|---|---|---|---|---|---|
| 3 | miles per hour. | 5½ horses' power. | 7 | miles per hour | 69 horses' power. |
| 4 | ... | 13 | 8 | ... | 102 |
| 5 | ... | 25 | 9 | ... | 146 |
| 6 | ... | 43 | 10 | ... | 200 |

I will venture to observe, at the same time, that it appears to me very doubtful, how far any of these tables can give correct *general* results in the high numbers. That a high velocity is always purchased by an extravagant waste of power is no doubt quite certain; as also, that in the boat or boats, on his experiments with which Mr Tredgold founds his table, this waste was such

## *A Tour to the South of France and the Pyrenees, in the year* 1825. By G. A. WALKER ARNOTT, Esq. F.L.S. &c. Continued from page 325. of Vol, V.

ON the 3d July, having procured a couple of mules, and having loaded them with ten or twelve reams of paper, and other necessaries for a fortnight's excursion, we took the road to Seo d'Urgel.

Having passed through Cerdagne, we arrived the same afternoon at Bourg-Madame (formerly called the Guingettes), a French village on the frontier, and close to the Spanish town of Puycerda.

Next morning we left this place, and arrived at Seo d'Urgel in the evening, after a march of thirty-four miles *, over a road rough and difficult even for foot-passengers. The picturesque nature of the country, and the great variety of plants that we saw about us, made us regret that we could not devote more time to the excursion, which we were prevented from doing, by a particular circumstance, which it is unnecessary here to mention.

Notwithstanding the disadvantages we laboured under between Mont Louis and Seo d'Urgel, we made some interesting additions to the Flora of the Pyrenees. Close to Salliagouse in Cerdagne, we discovered *Trifolium parviflorum;* and further on, near Bourg-Madame, we met with *Trigonella polycerata* and *Sisymbrium lævigatum.* This last plant was originally described by Willdenow, who remarks that it has all the habit of *S. asperum*, but that the siliquæ are glabrous: he only knew

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that nearly thirty times the power was requisite to give three times the velocity." Farther, it may be quite true that, if a power of 5¼ horses gives a velocity of three miles to any boat, the table may be correct up to perhaps six knots, or near it; because, thus far, I have no doubt that the resistance depends more on the weight of a boat than on its form, (see p. 236). But, beyond this, it is equally certain that form has a great influence; and thus, that one of two boats which has previously coincided, may acquire a velocity of ten knots with a less power than 200 horses, and the other may not be susceptible of it with almost any power whatever.

* Mr Bentham states "about twenty *lieues du poste;*" but the actual distance is only fourteen post leagues, or thirty-four English miles.

it in a cultivated state. Professor De Candolle, in his "Regnum Vegetabile," places it among the species little known, and adds, that what he has received from the German gardens under this name is merely *Diplotaxis tenuifolia:* in his Prodromus no notice whatever is taken of the plant. Sprengel, in his Systema Vegetabilium, adopts De Candolle's idea; and as Sprengel ought to be acquainted with Willdenow's plants, it is possible that ours may not be what Willdenow intended. Our Cerdagne plant, however, agrees well with his character; and indeed I can scarcely believe it to be any thing but a glabrous-podded variety of *S. asperum.* Between Bourg-Madame and Séo d'Urgel we observed many scarce Pyrenean plants, although they were to be met with in the warmer districts of France: indeed, during the whole route, we encountered a curious intermixture of meridional and alpine productions; and, from various circumstances, we had every reason to believe that this road had never before been trod by botanists. Among such as we gathered specimens of, chiefly for the sake of the locality, I may mention *Clematis recta, Alyssum halimifolium, Galium maritimum!* (we had already found this plant at Prades, at a great distance from the sea, and we here again found it still more inland, the nearest point of the shore being seventy miles, or, following the course of the Segre and Ebro, about two hundred miles from the sea), *Adonis æstivalis, Ononis Columnæ* and *striata, Myosotis lappula, Fumaria Vaillantii*[*], *Santolina squarrosa,* Benth. Cat. (but scarcely of other authors; I suspect

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[*] The "*Fumaria flaccida,* Fisch. mst., *F. officinalis,* var. auct." is, I think, identical with this species.

In a former Number of this Journal (April 1827, p. 243.), I had occasion to speak of *F. capreolata,* and from what I then stated, it may be supposed that I deny the existence of that plant in this country. It is, however, by no means uncommon, but much more scarce than *F. media,* DC. with which it has been often confounded. There is no doubt that both Smith and Withering had the Linnean plant in view, although all the English synonyms are referred by De Candolle to his *F. media. F. capreolata,* as it is found in the south of France, and as characterized by De Candolle, has the fructiferous peduncles most remarkably recurved. Such English and Scotch specimens, however, as I have seen, have them scarcely more than patent, and more frequently as erect as in *F. media;* which circumstance has tended to mislead the author of the Prodromus; but there are other characters which I consider of more importance: in *F. capreolata* the sepals are oval, scarcely acute, toothed it to be *S. ericoides*, Poir.), *Cytisus argenteus*, and *Nigella arvensis*. But there were other plants much more rare, and which we had not previously observed in our excursions: one was *Antirrhinum molle*, a species closely allied to *A. sempervirens*, but very distinct: it was exceedingly scarce, and not well in flower. Near it was *Stipa parviflora*, Desf. and *Delphinium cardiopetalum*, DC. We also found *Lavandula pyrenaica* in great abundance, and *Alyssum alpestre*.

I may here take the opportunity of observing, that when I first saw Mr Brown's amended character of the genus *Alyssum* in the Appendix to Denham and Clapperton's Narrative, it appeared to me, by the paragraph "ad Alyssum sic constitutum et herbas plerumque annuas pube stellari foliisque integerrimis complectens pertinent *A. campestre* et *calycinum* Linn., *strigosum* Russell, *minimum* Willd., et *strictum* ejusd. a quo *densiflorum* Desf. vix differt, *fulvescens* Sm., *umbellatum* Desv., *rostratum* Stev., *micropetalum* Fisch., *hirsutum* Bieb. aliæque species ineditæ," that he had the intention of restricting it to these species. Under this impression, I wrote the note printed long after at p. 323. of the Number of this Journal for October last. Having had, however, another opportunity last summer of looking over Mr Brown's paper, I felt inclined to attach more importance to the word "plerumque," than I had at first done, the few species mentioned by Mr Brown being all of them decidedly annual. On that account, it was my intention to have cancelled the note, as it passed through the press, and to have given in place the following observations, not upon, but in addition to, Mr Brown's remarks; but this, from my absence last autumn in Russia, I was prevented from doing.

at the base, but entire above, and *twice as long as the silicules.* This character will at all times distinguish this species, independent of the shape of the silicules, which are decidedly globose, and scarcely depressed at the apex. In *F. media* and *officinalis* the silicules are decidedly depressed or almost obcordate. But in *F. media* the sepals are ovate, lanceolate, acute, much toothed, and scarcely the length of the silicule: in *F. officinalis*, they are of the same shape and size as in *F. media*, but nearly entire. That *F. capreolata* is a good species, I cannot doubt; but I suspect much that *F. media* is the *F. officinalis*, growing in a rich soil. Among fields of potatoes, or in a kitchen-garden, I only find *F. media*, and when the soil is peculiarly rich, this plant has the leaves as thick and succulent, and the peduncles nearly as cirrhose, as *F. capreolata*.

As far as I have examined, I think that several of the perennial species come under the reformed character * as much as those enumerated,—indeed, I think all those with herbaceous stems, that belong to De Candolle's first subsection, with the exception of *A. gnaphalodes* and *A. petalodes*. With regard to the suffrutescent species, I feel every desire to separate them from the others; but I have not yet been able to find a character in which I dare put any confidence even for a subgenus. *A. alpestre*, *tortuosum*, *orientale*, *Gemonense* and *saxatile*, seem all of them to agree nearly with Mr Brown's character: I say nearly, for in some the funiculi, though nearly equidistant from the style in the same loculus, are scarcely opposite to those in the other loculus; but in all these, though some of them be described as having only one seed in each loculus, I find constantly four funiculi and ovula. In *A. argenteum*, however, and in *A. Corsicum*, Dub. (which Ph. Thomas brought from Corsica, and distributed under the name of *A. Salzmanni*, and which I consider scarcely distinct from *A. Bertolonii*, but of this my own specimen is not in fruit), I find truly one seed in each loculus, alternating with that in the other, both equally distant from the base of the style, and without any trace of a second funiculus or ovulum, precisely as in *Koniga maritima*. What of *A. murale* as is in my herbarium is not in fruit; but I have the authority of Professor Balbis for saying, that, upon cultivation, this and *A. argenteum* prove to be the same species. In both, I perceive from my notes, the seeds have a very small margin. When I had an opportunity of examining *A. obtusifolium* and *A. atlanticum*, both of which I at the time considered to be too closely allied to *A. Bertolonii* (although *A. atlanticum* has the silicules decidedly emarginate, and the flowers in a raceme, whilst in the other two, the silicules are never notched, and the flowers form a corymbus), I did not pay attention to the situation of the funiculi. In a specimen marked " *A. al-*

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* The reformed character is, " ALYSSUM: *Silicula subrotunda, disco convexo, limbo compresso, apice retuso, loculis dispermis, funiculis basi septo adnatis et post lapsum seminum persistentibus, supra liberis et cum iisdem deciduis, in diversis loculis oppositis, in eodem a styli basi æquidistantibus: Petalis emarginatis: Filamentis omnibus nonnullisve appendiculatis in speciebus omnibus præter* A. calycinum *in quo filamenta filiformia simplicia sunt et glandularum loco setulæ quatuor filamenta nana æmulantes extant.*"

*pestre,*" from the Zurich garden, there is but one seed and one funiculus in each loculus; but as I have my doubts of its being well named, I will not draw the otherwise natural conclusion of this character being of no importance, as in the native plant there are certainly two funiculi and ovula in each loculus. As to *A. edentulum, halimifolium* (with which the Pyrenean *A. macrocarpum* of De Candolle's "Regnum Vegetabile," "Prodromus," and "Botanicon Gallicum," is identical), and *A. macrocarpum* (from the Lozère, and from which *A. pyrenaicum,* Lapeyr. and DC. does not differ), the two funiculi are equidistant from the base of the style in the same loculus, though one of the seeds may be abortive, but to those in the other loculus I do not find them always exactly opposite: the relative position, however, in the same specimen, is variable, which makes me inclined to think that they are all modifications of the opposite funiculi. To separate these, then, from *Alyssum,* we have little left as a character except the "*stamina edentula;*" and Mr Brown very justly remarks, that, in *A. calycinum,* the stamina are so likewise. I pass over here the character of the umbonate valves, which, in addition to those species mentioned by Mr Brown, applies to *A. montanum, diffusum, Lenense* [*], *lanigerum* [†], and probably the others with herbaceous stems, as well as perhaps, though not so strictly, to one or two of the suffrutescent species, as I look on that more as an auxiliary than a good *per se* generic character.

I have noticed above *A. gnaphalodes* and *A. petalodes.* The former has the calyx slightly bisaccate at the base: the two smaller stamina are furnished with a tooth-like appendage, the others not; the valves of the silicule are plane; the funiculi are horizontal; there are from eight to twelve ovula in each loculus; and the seeds, as far as I could judge of the immature ones, were destitute of a winged margin. It is therefore not an *Alyssum*, but a *Farsetia*, from the character of which it only differs by the immargined seed; and I ought to observe, that an approximation to that takes place in *F. triquetra*, which has the seeds very obscurely margined; and *A. gnaphalodes* agrees with that in habit. As to *A. petalodes*, it is an *Aubrietia*, and very (too ?) closely allied to *A. purpurea* *: the calyx is bisaccate at the base; the two smaller stamina have a tooth at the base, and the four larger ones towards the apex; the petals are of a red colour.

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[*] I suspect this may be the same with *A. lanigerum.* The stems are herbaceous and swollen in the middle: the fruit on the specimen I examined was very young; the fructiferous peduncles were patent.

[†] The stems are decidedly herbaceous, and remarkably swollen in the middle (tapering towards the flower and root). The root is certainly I think annual, perhaps biennial: the stem and leaves are not *woolly* or *tomentose,* but merely rough; the silicule is not at all emarginated; the fructiferous peduncles are patent; the seed scarcely margined. Perhaps it is only a variety of the variable *A. campestre.*

But to return from this digression.—Close to Seo d'Urgel, in the dried-up bed of the Segre, we gathered what at the time we supposed to be *Andryala lyrata*, a plant we had previously found at Perpignan: it proves, however, to be that state called *A. incana*. Professor De Candolle has united the *Rothia* of Gærtner to *Andryala*, and it appears to me with great justice. As to the *A. lyrata*, Sprengel has put it into the genus *Rothia*, and *A. incana* into *Andryala*. I feel quite certain, however, when I say, that the *A. incana* is the autumnal state of the other. I do not find the seeds of the outer ray destitute of pappus in either, nor indeed have I found such to be the case in any of the French species. With *Rothia Andryaloides*, the type of the genus, I am unacquainted.

"If a time arrive when people can travel through this unfortunate country with comfort, or even personal security, and botanists think of repeating this excursion, it would be preferable to remain at least a week at Bourg-Madame, and from thence make daily excursions to the heights of Jacca, to Caroll, and particularly to the valley of Spanish Cerdagne, where the fields and meadows are not too well attended to, and the uncultivated lands sufficiently numerous to afford an ample harvest to the botanist. To Seo d'Urgel might occupy two days; and even a third spent in the vicinity of Martinet, where one must then sleep two nights, would not be lost.

"Seo d'Urgel, celebrated in the last war as the head-quarters of the provisionary government, and by the sieges it has undergone, is a paltry town, agreeably situated in a small plain at the confluence of the three valleys of the Segre, the Bellver, and Andorra. The high mountains that surround it have a wild and picturesque appearance, in perfect harmony with the rudeness of the peasantry, their houses, and indeed, generally speaking, all the productions both of nature and art. The forts that command the town, are in their turn commanded by the surrounding heights. If they have been able to bear several sieges, it is merely because it did not enter into the thoughts of the enemy to bring cannon into a country distant forty leagues from any road practicable for carriages; and when, during the last war, the French engineers transported there some pieces of artillery, it was with inconceivable trouble and loss of time, an entire month being requisite for the conveyance between Mont Louis and Seo. When the French approached, they easily took the town, indeed the gates might have been burst open with the foot; they afterwards set fire to part of it, in order to induce the fort to surrender, but to no purpose. At length, however, the cannon arrived, and this was effected with such secrecy, that the Spaniards, taking no precautions to inform themselves of the movements of their adversaries, had not the smallest idea of the possibility of such an undertaking, until one beautiful morning they were awakened by a discharge of balls and bomb-shells. They were so completely dismayed, when they raised their eyes, on seeing the battery erected during the night above their heads, that they made no more delay about surrendering the fort."—B.

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* *Aub. Columnæ*, Guss. and Column. Ecphr. i. p. 282. t. 284. as far as I can judge, by the miserable specimen I possess, is identical with *Aub. deltoidea*.

Seo d'Urgel, on account of its situation, is seldom a day during the whole summer without experiencing a tremendous storm. This limited our excursions. Indeed, with the exception of one to the top of Mont Cady, we contented ourselves, during our short stay, with exploring the immediate vicinity of the town: we were very fortunate notwithstanding, when we gathered *Caprifolium etruscum*, *Medicago suffruticosa* (*α*, Benth., which alone was known to prior botanists), *Inula helenioides* and *montana*, *Aristolochia pistolochia*, *Centaurea crupina*, *Campanula linifolia*, var.? (*caule inferne foliisque inferioribus pubescentibus, superne glabro, corolla parva; an potius* C. rotundifolia, *var.?*), *Lathyrus tuberosus* and *cirrhosus*, Ser. This last mentioned species we considered to be *L. heterophyllus*, and it is under this name in Mr Bentham's Catalogue; but Mr Bentham has lately informed me, that the true *L. heterophyllus*, as it is cultivated, is a very different plant. I have long ago ascertained our plant to be *L. cirrhosus*, Ser. (gathered by Ph. Thomas in the neighbourhood of Olette), by means of an original specimen; but in order to avoid any mistake in others who may detect again this species, I must remark, that, by a singular confusion, this is placed in a section of *Lathyrus*, not only by Seringe, in De Candolle's "Prodromus," but by Duby, in the "Botanicon Gallicum," with which it does not agree. The character, as given, is to have the petiols many- (5 or 6-) leaved, and the peduncles many-flowered, while it is put into the section "*Annui, pedunculis 1–3-floris, foliis 2–3 jugis.*" The root, however, is really perennial, and it belongs to the section "*Perennes, pedunculis multifloris, foliis multijugis,*" and it must be arranged next to *L. heterophyllus*. I may add, that the other species of this last section seem to be ill understood; for my part, all the specimens that I have seen of *L. venosus*, *myrtifolius* (with which Torrey says *L. stipulaceus* Le Comte, is identical), *polymorphus* and *pisiformis*, appear to me states of *Pisum maritimum*.

Our expedition to the summit of Mont Cady, on the 6th, was also, on the whole, a prosperous one. This mountain consists of three separate ridges. To the first is a very long, but not very steep ascent; and unless *Lavandula pyrenaica*, which was everywhere, *Siderites hirsuta*, *Vicia onobrychoides*, and one or two specimens of *Trifolium lagopus*, we scarcely saw any plant of interest. The second ascent is much more steep, particularly as, instead of following the easiest, or mule road, up to the ridge, we took the shortest, and mounted through a wood as straight as a narrow footpath among the trees permitted us. Here the plants we observed of note were *Teucrium pyrenaicum* and *Hypnum rugulosum*, Web. and Mohr, which last was very common all the way from Seo. Towards the base of the third ridge, however, we found every thing more interesting: here were *Onopordon pyrenaicum*, *Scutellaria alpina*, and *Ononis cenisia*. On our ascent to the high peaks, we examined the rocks on our right, and found *Ramondia pyrenaica* *, and *Va-*

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* De Candolle's description of the fruit of this genus, in the "Synopsis Floræ Gallicæ," and repeated word for word in the "Botanicon Gallicum," "*Capsula 1-locularis, 2-valvis, valvulis margine introflexis septiferis,*" appears to

*leriana globulariæfolia* * (which, however, was more abundant nearer the top), *Timmia polytrichoides*, *Lonicera pyrenaica*, and *Saxifraga longifolia*, but not in flower. About half way up the ridge, we came to a small piece of level ground, on which, to our surprise, we saw several very lowland plants, as *Ornithogalum umbellatum* and *Helianthemum penicillatum*, mixed with others of an alpine appearance, as *Anthyllis montana*, *Plantago sericea*, and *Aster alpinus*. Towards the summit we

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me to be contradictory and incomprehensible. I have never seen the mature fruit, but the structure of the ovarium is as follows: It is unilocular; the margins of the future valves are introflexed, and united for some way to the contiguous margins of the other valves; they then divaricate, and bear towards their extremity the placenta, to which are attached the very minute and numerous ovula: the capsule opens by the separation of the introflexed margins. This structure is perfectly analogous to what we find in the *Gentianeæ*, but with which tribe our plant has nothing else in common. If we now suppose the introflexed margins to be sufficiently elongated, and to reach nearly the centre of the fruit, we shall have the bilocular capsule of *Verbascum*; and I, therefore, agree with those who have hitherto left *Ramondia* among the *Solaneæ*.

I am aware that M. A. Richard has lately taken a different view of its structure. He describes the introflexed margins as "two opposite parietal placentæ or trophosperms, simple at their origin, but split each internally into two divaricating and recurved laminæ, the inner face of which is entirely covered with the ovula;" but from my observations, the ovula are only attached to the extremity of this body, which induces me still to think, that what is to him the simple part of the placenta, is really the introflexed margin of the valves. On account of this supposed structure, Richard approaches *Ramondia* to such of the *Gesneriaceæ* as have the ovary free, from which it differs by the equal corolla and stamens; but in which respect he acknowledges its affinity to the *Solaneæ*. With regard, again, to the *Gesneriaceæ* with the ovary free, including *Columnea*, *Achimenes* (or *Trevirana*), *Besleria*, and perhaps *Arragoa*, Richard has also proposed to separate them from the *Gesneriaceæ*, and unite them to the *Orobancheæ*; but in the latter tribe, when the capsule opens, the placentæ are found not marginal, but in the middle of the valves, (it is so at least in *Orobanche*, *Phelypea*, *Lathræa*, and *Epiphagus*); and this, though not of itself a character of sufficient importance, yet, when joined to the remarkable difference of habit, and to the circumstance that, in the *Orobancheæ*, the small embryo is situated laterally near the apex (not at the base, as Dr Hooker states in his Flora Scotica) of the fleshy albumen, ought to keep them distinct. I may remark here, that the whole of the *Gesneriaceæ* require to be reconsidered; the few that I have examined differ slightly from the character of the order as given by Richard.

* This appears to me to be a mere variety, with the cauline leaves pinnatifid, of *V. saxatilis* of the Alps.

found everywhere *Galium pyrenaicum* and *Petrocallis pyrenaica* (which, from its cuneiform and trifid leaves and red flowers ought never to have been ranked with *Draba)*; and again, on our descent, we met with *Vicia pyrenaica*, and a very few specimens of *Serratula humilis* * and *Astragalus purpureus*.

By the time we had got again to the bottom of the first ridge, we perceived the commencement of a thunder-storm, and we therefore resolved to descend as rapidly as possible; indeed, so expeditious were we, that we performed the distance to Seo in less than two hours and a quarter, which we have been informed required at least five hours. The usual time for the ascent and descent is about eighteen hours. A French officer of the garrison at Seo had a short time ago accomplished the whole in twelve, but received little belief from his brother officers. We had started at a quarter before five in the morning, and returned a few minutes before three, having been only ten hours absent, and having had sufficient time to breakfast, and to botanize out of the straight road: one who is not so engaged may do the whole in eight or nine hours. I mention this as an estimation of the distance of Mont Cady, for such as may be inclined to make the excursion. There is no occasion, as one is advised at Seo, to spend the night on the mountain. The road up is tolerably good, and the scenery wild: cultivation of some kind is to be seen in all the valleys, even in that at the foot of the highest ridge. We had no instruments with us by which we could have ascertained the elevation, but we were informed, that, had the weather been clear, we ought to have seen Mont Louis from the summit: the fogs were, however, very intense, and only cleared away for a few minutes on the side of Seo d'Urgel, which we saw. The peals of thunder were so constant, that before the short echo of one was over, another burst upon our ears; so that for about two hours, or even more, there was, as it were, an incessant roll.

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* The genus *Serratula* has been of late much divided, but perhaps *Saussurea* and *Rhaponticum* are the only two that deserve to be retained. *Klasea* and *Stemmacantha* of Cassini are scarcely worth notice. As to *Malacacanthus* of Fischer, distinguished by the linear squarrose scales of the involucre, and including *Serratula mollis*, *cyanoides*, *polyclonos*, and *alata*, W., it differs in no other respect from the *Serratulæ*; and that character is impaired by *S. mucronata*, Desf. in which the tips of the scales are reflexed. Some species of *Serratula*, as *S. humilis*, have the scales patent, while in others they are close pressed. There is, therefore, a gradation from those in which the scales are close pressed to those in which they are squarrose. I cannot resist taking notice here of Cassini's characters. That he is an acute observer no one will deny; but he appears more inclined to describe plants as they are, as distinct species or genera, than to observe their variation. The genus *Mutisia*, for example, has been split by him into three, distinguished by the appendage of the scales of the involucre; but these scales are certain modifications of the leaves of the plant, and the more the plant tends to throw out cirrhi from the leaves, the more evident is the appendage to the scales; but between *M. inflexa* and *linearifolia* there are such transitions, as to create a doubt how far these species are distinct, much less can they be put into different genera.

Before we left France, we had been assured that M. Bolois, a physician from Olot in Catalonia, had rediscovered the locality of *Salvia pyrenaica* in the vicinity of Seo d'Urgel. This fine species was first observed by Fagon, and afterwards by Tournefort; but the plant, as well as the locality, is almost unknown to modern botanists. Notwithstanding we looked particularly for it, we did not see any thing like it. I believe that Asso, in his account of the plants of Arragon, gives the locality for this species; but I neither have the work, nor have the means at present of referring to it.

Upon the whole, the best ground for the botanist about Seo d'Urgel, appears to be in the valleys along the Segre, particularly below the town.

On the 7th, we arranged the plants we had gathered the day before, as it was not a day suited for an excursion,—no less than three thunder storms, accompanied with tremendous falls of rain, having passed over the town. Two houses that were partly burned by the French a year and a half before, were shattered to the ground. This day was also the *fête* of the town; but the priests having assured the people that the rains which had fallen every day for at least six weeks were as a punishment inflicted on them for their sins, particularly against the government, had interdicted dancing: it was of little consequence, as the rain must have, without the assistance of the priests, put a stop to that amusement.

On the 8th, we had the prospect of a delightful day, and we accordingly left Seo d'Urgel at six in the morning for the valley of Andorra, having previously procured some days' provision of wheaten bread. At the gate of the town, the officers of police, for the first time since our arrival, insisted on seeing our passports; but they were instantly returned when they found they were not written in a language which they understood. On the frontier the Spanish custom-house officers, to our surprise, behaved to us very civilly, merely asking if the paper, &c. belonged to ourselves, and if there were any thing but clothes in our portmanteaus; but we afterwards found that our muleteer, who did not in the least relish the idea of unpacking our luggage, and who had got in advance while we were gathering some plants, had previously informed them that we were French physicians travelling in search of herbs, and that if we were molested, we would report them to the garrison at Seo: and so frightened and jostled were the poor Spaniards here by the French, that they allow them to do any thing.

"From the frontier to Andorra, the road is along a deep valley, in which the scenery is picturesque and varied. At one place the valley is exceedingly narrow, and studded with rocks almost perpendicular, which rise to a great height, and whose dark and sombre hues add to the grandeur of the place. At other places the valley widens into little plains, containing two or three villages, miserably built, and so black, both inside and out, that we could not resist inquiring if it were the custom here to paint their houses of that colour; but it was only the effect of the smoke of the wood of the pine-tree, which they burn in winter both for light and heat."—B.

Having breakfasted at St Julia, we arrived at Andorra, the capital of the republic, in the afternoon. It was our intention to have sent on our mules to the town, and to have ascended the Pic d'Anclas, which is close to it. This was said to have been once explored in 1811, by some one in search of an "*Onosma* with flowers, like a rose," as the description held forth that we got at Seo d'Urgel; but as we could not find out who the botanist was, and did not place much faith in the story, and as it was later than we expected, we gave up the excursion. On our arrival, having stopped before what we were told was the principal inn, we began to unload our mules, when the old woman who kept it, understanding that we wished to sleep there, informed us that we must go elsewhere, as the only bed she possessed was then occupied by her sick husband. Fortunately, however, Andorra possessed another, the master of which obligingly offered us his own bed, which we accepted.

*(To be continued.)*

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## *Analysis of several Species of the Zeolite Family from Scottish Localities.* By A. CONNELL, Esq. Communicated by the Author.

ALTHOUGH the greater number of the species of the zeolite family have been often analysed, yet, in so far as I know, no analysis of the following minerals from the particular localities there mentioned has been made public; and it is obviously of great importance, with a view to an accurate knowledge of the atomic constitution of minerals, that an examination should be made of individual minerals, from as many different localities as possible. It is thus that we shall best learn what ingredients and what proportions are essential to the true constitution of the several mineral substances, and what merely result from accidental circumstances peculiar to the several localities.

### 1. Chabasite, *Haüy*,—Rhomboidal Zeolite, *Jameson*.

The first mineral which I shall notice is *Chabasite* or *Rhomboidal Zeolite*, the analysis of which, although it has been often repeated, possesses considerable interest, because this substance has been selected by Berzelius as one of his illustrations of the doctrine now so universally adopted by the Swedish and German chemists, that certain ingredients of minerals are capable of *replacing* one another in variable proportions, without effecting any change in the essential nature of the species, or in its crystalline form. According to these chemists, there are, as is well known, two classes, the substances respectively contained in which are capable of mutually replacing one another in mineral substances. The one of these consists of those oxides which contain one atom of oxygen only. Such are, lime, magnesia, the fixed alkalies, protoxide of iron, &c. The other embraces those oxides which, according to the peculiar views of Berzelius, contain three atoms of oxygen; and of these, alumina, peroxide of iron, &c. are examples *. As these views respecting the constitution of the latter class of oxides have not been adopted by the chemists of this country, they appear also to have been slow to embrace the theory of replacement in mineral substances which has been considered as essentially connected with these views.

The objections also, which have been urged against the particular instances brought forward by Mitscherlich in support of the analogous, or, perhaps to a certain extent, identical theory of *Isomorphous* substances, as first promulgated by him, have had a similar effect on the chemists of this country. Yet still it is perhaps worthy of attention, whether the doctrine of the replacement of certain classes of ingredients in mineral substances, without really changing the nature of these substances, is not wholly, or to a considerable extent, borne out *by facts*, as appearing from the actual analysis of various minerals; and whether this doctrine may not therefore be regarded as a law either of universal application in the Mineral Kingdom, or at least as holding good with respect to certain species of mineral substances. If, after careful observation, this should be held to be the case, it will then perhaps be time enough to enquire, whether this law necessarily involves the truth of the hypothesis, that certain oxides contain one atom of oxygen only, whilst certain others contain three atoms, or whether it may not be connected with some other peculiarities, at present unknown, in the nature of these oxides. I may at least, I think, suggest, without professing myself a convert to the theory of replacements, that, in so far as its truth or falsehood is capable of being established *by facts*, it merits more attention that it has hitherto received from the chemists of Great Britain. Any one, I think, must be satisfied of this, who attends to the well-known and remarkable illustration of the doctrine, in the analysis of thirteen different varieties of garnet by Wachtmeister †, where the replacement of the two classes of ingredients was found to occur in a very singular manner; or to some of the more recent analyses, as that of Fahlunite by the same eminent analyst [*].

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* The original doctrine of Berzelius was, that the substances constituting the former of these classes contained *two* atoms of oxygen, but he now holds that they contain *one* only.

† See an abstract of these analyses in the Annals of Philosophy, No. v. vol. ix.

Our attention, however, at present, more immediately concerns the composition of Chabasite. With respect to this mineral, Berzelius makes the following statement in the observations which he has prefixed to his general collection of mineral formulæ,—[†]

"The Chabasite consists, according to the earlier analysis, of $\dot{C}a^3\,\dddot{S}i + 3\,\underline{\dddot{A}}l\,\dddot{S}^2 + 18\,\underline{\dot{H}}$ a little of the lime being replaced by potassa. More lately I have analysed a chabasite sent me from Scotland under the name of Levyine, in which a little of the lime was replaced by potassa and soda. M. Ardfwedson has analysed a chabasite from Scotland, in which all the lime was exchanged for potassa and soda. It is thus clear that there are chabasites which contain lime principally, and others which contain soda principally, and that in all the bases, lime, potassa and soda, can replace one another in indeterminate proportions; so that thus the chabasites, from different localities, may be differently composed without losing the general formula." In another paper [‡], Berzelius has brought together the following analyses of this mineral from different localities.

| | FERROE [‖]. | SCOTLAND [§]. | GUSTAFSBERG [¶]. |
|---|---|---|---|
| Silica, . | 48.30 | 49.17 | 50.65 |
| Alumina, | 19.28 | 18.90 | 17.90 |
| Lime, . | 8.70 | | 9.73 |
| Soda, . | | 12.19 | |
| Potassa, . | 2.50 | | 1.70 |
| Water, . | 20.00 | 19.73 | 19.50 |
| | 98.86 | 99.99 | 99.48 |

In the same paper he has also given an analysis of Levyine which he there considers as a chabasite; but from the explanation afterwards given by Dr Brewster [**], who sent to him the specimen submitted to analysis, it is quite clear that Berzelius had not distinguished between the Levyine and some chabasite contained in the same specimen; and that in reality the substance analysed consisted of a mixture of both minerals; so that this analysis may be laid aside.

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[*] Poggendorf's Annalen, xiii. 70.

[†] See Poggendorf's Annal. xii. 4.

[‡] An. de Chemie, et de Phys. xxxi.

[‖] Analysed by Ardfwedson.

[§] The Soda in this kind contains a litttle Potash.

[¶] Afhand. i. Fysoch. Kemi, &c. iv. 193.

[**] Edin. Jour. of Science, vol. iv. 316.

From the view adopted by Berzelius that in chabasite, the lime, potassa and soda may replace one another in variable proportions; and from the circumstance that the mineral found by Ardfwedson to contain no lime, was from Scotland, I was anxious to know what might be the constitution of a chabasite from Renfrewshire which I had obtained, and therefore submitted it to analysis.

The chabasite analysed was in crystals, from the size of one-fifth of an inch to one-tenth, which had the usual rhomboidal form, a very few being slightly modified by truncations on some of the edges and angles. The greater number were transparent and colourless, although a few had a brownish tint. They were in one of the specimens associated with crystals of stilbite, from which, however, they were very carefully separated.

The method of analysis followed, was that usually adopted in regard to those zeolites which are completely decomposed by acids. The general nature of the constituents having been examined in a previous trial, the mineral reduced to impalpable powder was treated with muriatic acid, and the gelatinous substance evaporated to dryness. The soluble salts were then taken up by hot water, acidulated with muriatic acid; and the silica was separated by filtration, ignited and weighed. The solution was next precipitated by ammonia, and the alumina separated, ignited and weighed. The lime was then thrown down by oxalate of ammonia; the oxalate of lime was moderately calcined; and the quantity of lime determined from the composition of the carbonate thus obtained. The solution, after the separation of the earthy ingredients, was evaporated to dryness, the residue ignited to expel the salt of ammonia, and its weight then determined. This residue was redissolved in water, and left a little silica undissolved, which was collected and weighed; and its weight then subtracted from that of the whole residue. In the preliminary trial, the mineral had been found to contain potassa; and, in order to determine whether it also contained soda, the solution, after separation from the small residue of silica, was concentrated by evaporation, mixed with muriate of platinum, and gently evaporated to dryness. It was then treated with alcohol. The alcoholic solution, after being mixed with sulphate of ammonia, was evaporated to dryness; and the residue ignited, and then treated with hot water, to take up whatever was soluble. This solution, by spontaneous evaporation, yielded a small quantity of prismatic crystals, having all the appearance of sulphate of soda, and efflorescing in the air. From these circumstances, and from the manner in which they had been obtained, there can be no doubt that they were that salt, and the mineral, therefore, contained a little soda; but as the potassa calculated from the chloride of platinum and potassa left undissolved by the alcohol, and the soda calculated from the sulphate obtained, did not fully make up the total soluble residue of the mineral, I have not given the *proportions* of these alcalies in relation to one another, but have stated the residue as potassa mixed with a little soda, the former alcali constituting by far the greater proportion.

The quantity of water in the mineral was determined by igniting a portion of it in a platinum crucible.

The result of the analysis gave, in 100 parts,

| | |
|---|---|
| Silica, | 50.14 |
| Alumina, | 17.48 |
| Lime, | 8.47 |
| Potassa mixed with a little soda, | 2.58 |
| Water, | 20.83 |
| | 99.50 |

Thus this analysis gives nearly the same proportions as those of the chabasites of Ferroe and Gustafsberg already mentioned; and is also nearly conformable to the composition of the Scottish mineral analysed by Ardfwedson, except in so far as regards those ingredients, which, according to the theory both of the British and of the foreign chemists, contain one atom of oxygen only; and, with respect to these, that species of replacement mentioned in the preceding quotation from Berzelius may be held to occur. The lime may be viewed as replaced in Ardfwedson's Scottish mineral by soda.

The formula for chabasite given in the paper of Berzelius containing the analyses of the mineral, is $\left.\begin{matrix}C\\N\\K\end{matrix}\right\}S^2+3\,AS^2+6\,Aq$; the first bracket expressing the replacements of the lime, potassa and soda. In the last published collection, however, of his formulæ *, that for chabasie is thus framed, $\left.\begin{matrix}\dot{N}^3\\\dot{K}^3\end{matrix}\right\}\dddot{S}^2+3\,\underline{\dddot{Al}}\,\dddot{Si}^2+18\,\underline{\dot{H}}$, which corresponds with the more simple formula of $\left.\begin{matrix}N\\K\end{matrix}\right\}S^2+3\,A\,S^2+6\,Aq$. But as there is little doubt that the *lime* chabasites, are much more common than the *soda* chabasites; it seems, with every possible deference for so great a name as that of Berzelius, objectionable to adopt a formula, in which the most ordinary of the three replacing ingredients is omitted. Indeed a doubt may be reasonably expressed, whether the mineral analysed by Ardfwedson, was really a chabasite. I have examined, in a general way, chabasites from three other localities, besides those already mentioned, namely, one from Ireland, another from the Island of Skye, and a third from Iceland; and, in all of them, lime was found to be a pretty abundant ingredient: and although the nature of the whole of their constituents was not determined, I think there is every reason to believe that they are constituted in a manner very similar to the lime chabasites, already mentioned. Even if we should leave soda entirely out of view as a replacing ingredient in chabasite, it still may be held, that replacement occurs within certain limits between the lime and potassa; as these ingredients will be found to vary somewhat in proportion in the above mentioned analyses, the one increasing, as the other diminishes.

In the whole circumstances, the formula of $\left.\begin{matrix}C\\K\\N\end{matrix}\right\}S^2+3\,A\,S^2+6\,Aq$, is perhaps the best calculated to express the general composition of the mineral.

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* Poggend. Annalen, xii.

## 2. Laumonite, *Werner*,—Diatomous Zeolite, *Jameson*.

The next mineral of which I shall give an analysis, is Laumonite, or *Diatomous Zeolite*. The constituents of this mineral have been given by Gmelin and Vogel, as follows:

| | | |
|---|---|---|
| Silica, . . | 48.30 | 49.00 |
| Alumina, . | 22.70 | 22.00 |
| Lime, . . | 12.10 | 9.00 |
| Water, . . | 16.00 | 17.50 |
| Carbonic Acid, . | | 2.50 |

The formula which has been given by Berzelius for its composition is, $\dot{C}a^3\,\dddot{S}i^2 + 4\,\underline{\dddot{A}l}\,\dddot{S}i^2 + 18\,\underline{\dot{H}}$, which corresponds to,

| | |
|---|---|
| Silica, . . . . | 50.95 |
| Alumina, . . . . | 22.89 |
| Lime, . . . . | 8.91 |
| Water, . . . . | 17.19 |

The specimen of laumonite analysed by me, was from the parish of Snizort, in the Island of Skye. It consisted of an aggregation of small crystals, forming a kind of crystalline mass, having a moderate degree of coherence; the colour white, with a tinge of red.

When analysed it was in a quite fresh state, and had not suffered any of that decomposition to which this mineral is subject.

The mode of analysis followed, was precisely the same as that employed in the determination of the earthy ingredients of the chabasite. In no instance, when it was treated with muriatic acid, did I observe any effervescence. Hence, and as it was completely decomposed by the acid, it could have contained no carbonic acid; which was found to be an ingredient in the variety analysed by Vogel. The result gave in 100 parts

| | |
|---|---|
| Silica, . . . . . . | 52.04 |
| Alumina, . . . . . | 21.14 |
| Lime, . . . . . | 10.62 |
| Water, . . . . . | 14.92 |
| | 98.72 |

The mineral analysed, thus contained more silica than in the analyses of Vogel and Gmelin. It corresponds, in so far as respects that ingredient, more nearly with the formula of Berzelius. It contained less water than usual.

### 3. Analcime, *Hauy*,—Hexahedral, or Cubic Zeolite, *Jameson*.

The last mineral of which I shall at present give an analysis is *Analcime*, or *Hexahedral Zeolite*.

A specimen of this mineral from the Tyrol, was found by Rose * to consist of

| | |
|---|---|
| Silica, . . . . . . | 55.12 |
| Alumina, . . . . . | 22.99 |
| Soda, . . . . . . | 1353 |
| Water, . . . . . | 8.27 |
| | 99.91 |

The formula of Berzelius, $\dot{N}^3\,\dddot{Si}^2 + \underline{\dddot{Al}}\,\dddot{S}^2 + 6\,\underline{\dot{H}}$, gives very nearly the same proportions, viz.

| | |
|---|---|
| Silica, . . . . . . | 55.17 |
| Alumina, . . . . . | 23.27 |
| Soda, . . . . . . | 13.87 |
| Water, . . . . . . | 7.75 |

A specimen of analcime from Old Kilpatrick, in Dumbartonshire, I found to be composed nearly in conformity with these proportions; and after making allowance for the imperfections of analysis, I have no doubt that it had exactly the same constitution as the Tyrol analcime, analysed by Rose. The Kilpatrick analcime was partially crystallized. Its colour was white, with a very pale rose tint. It was translucent on the edges. Fracture uneven.

After determining the general nature of its ingredients by a preliminary trial, the mineral, in fine powder, was treated with muriatic acid, and the silica separated as usual. The alumina was then precipitated in one analysis by carbonate of ammonia, and in another by caustic ammonia, and its quantity determined after ignition. The remaining fluid was evaporated to dryness, and the residue ignited and weighed. Re-dissolved, it left a little insoluble matter, which was a mixture of silica and alumina. The solution, when concentrated, gave no precipitate with muriate of platinum, and, by evaporation, gave cubical crystals. They were, therefore, chloride of sodium, from which the quantity of soda was calculated.

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* An. de Chimie, et de Phys. xxv. 192.

The mean of two analyses gives the following result:

| | |
|---|---|
| Silica, | 55,073 |
| Alumina, | 22.225 |
| Soda, | 13.711 |
| Water, | 8.217 |
| | 99.226 |

## *On the Colouring of the Leaves in Autumn.* By M. MACAIRE PRINSEP *.

EVERY person has been struck with surprise, and often with admiration, on viewing the varied and glowing colours with which nature suddenly invests the vegetable creation in autumn. It seems as if, after gratifying the eye of man, by a mild and almost uniform tint, during the period when the sun displays all his brightness, she took advantage of the last moments that remain to her for unfolding all her power, by giving to the landscape the richest and most varied hues, and terminating by this brilliant display the exhibition of the yearly phenomena of vegetation. This remarkable change has naturally attracted the attention of physiologists; but scarcely any have viewed it otherwise than in a cursory manner, and as connected with another fact, the fall of the leaves, the explanation of which has seemed to them of much greater importance. Thus several, as M. de Lamarck, have viewed this autumnal colouring of the leaves as a diseased state; M. Senebier, as an alteration or diminution in their nutritious juices, which only prepares their fall by paralysing the upper network of the leaves. It has appeared to me that these two phenomena were so far independent of each other as to demand a separate examination, and although in general it cannot be denied that the fall of the leaves is often preceded by their change of colour, there are many cases in which the leaves fall green, and others in which they change colour before falling. This distinction is of some importance, for if the change of colour in the leaf be only a casual antecedent of its fall, it must be considered as a commencement of death, as most physiologists have considered it; whereas I think it ought to be viewed as a phenomenon of the life of the vegetable, a consequence or continuance of the regular action of the same agents which preside over the other functions of the plant,—an opinion which the few facts adduced in this memoir may perhaps serve to confirm.

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* Memoires de la Societé de Physique et d'Histoire Naturelle de Geneve. tom. iv. pr. I.

It is, as every body knows, at the end of summer, or in the course of autumn, that the change of colour in the leaves, which forms the subject of our examination, is produced. However varied the tints may be which they present, it may be said, that, with a small number of exceptions, they come to shades of yellow or red, which are at this period the predominant colours in the landscape. This change is far from being sudden. In general the green colour disappears by degrees in the leaf; many leaves, however, as those of the acacia and apricot, begin to grow yellow here and there, and in spots. In others, as the pear-tree, &c. there long remain dots of a beautiful green on the orange or yellow-ground of the leaves. Some, as those of the Rhus coriaria, begin to change at their edges, and especially at the tip. The nerves and the parts of the parenchyma which touch them, seem to retain the green colour longest. I think I have observed that the leaves whose green is deep assume the red colour, and those whose green is pale, the yellow or yellowish tint. Most of the leaves, however, which become red, pass through the yellow as an intermediate tint; as in the Rhus coriaria.

*Influence of Light.*—It were easy to see that the action of light exercises a great influence upon the autumnal change of the colour of the leaves in the leaves which naturally cover each other in part, the uncovered portion being always more quickly and more deeply coloured. It was of importance to determine if the phenomenon might take place in darkness, and on entirely sheltering from the action of light, either the whole branches, or parts of leaves. I always found that, in this deprivation, all change of colour was prevented. If the entire leaf was placed in the dark, it fell off green; if only a part, the rest of the parenchyma changed colour, and the covered portion retained its original colour. I satisfied myself further, that light was necessary in all the phases of the phenomenon, and if I placed in the dark leaves or portions of leaves which were yellow before reddening, as the Rhus coriaria, the leaf fell off yellow, or the covered part retained that colour, while the rest became red; which demonstrates the necessity of the action of light in all the stages of colouring.

*Action of the Atmosphere.*—Every body knows, and it is especially to the beautiful experiments of M. de Saussure, that the demonstration of this important fact is owing, that the green parts of plants absorb during the night a variable quantity of oxygen, according to the different species, and that they expire a certain proportion of that gas when they are exposed to the sun in spring water. Being curious to know the modifications which the autumnal colouring of the leaves might induce in this phenomenon, I made several series of experiments, following the indications of M. de Saussure in the most scrupulous manner possible. I satisfied myself in the first place, that the already coloured leaves do not disengage oxygen gas by exposure to the sun's light, and I afterwards learned that this fact had been ascertained by M. Senebier. Pushing my inquiries farther, I found, that, when the leaves were either coloured in part, or at the point of changing colour, even although they yet appeared green to the eye, they, from that moment, ceased to give out oxygen in the sun. I also found, by a great number of trials, the particulars of which I intend to make known, that the leaves, on arriving at the very point where the tendency to the autumnal colouring commences, continued to inspire oxygen gas during the night, and in a quantity always decreasing in proportion as the colouring advanced; which allowed me to conclude that it was to the fixation of the oxygen in the colouring matter of the leaf that the change of tint was owing.

*Of the colouring principle of the Leaves.*—Some years ago, MM. Pelletier and Cavantou discovered that the green substance of the leaves possesses peculiar properties, and ranked it, under the name of *chlorophyle*, among the immediate products of the vegetable kingdom. This substance appearing to be the seat of the modifications which take place in the colour of the leaves, it was necessary for me to submit it to examination. After examining anew the properties which it possesses, I set myself to examine the corresponding substance of the leaves coloured yellow and red by the autumnal influence. To obtain the chlorophyle, MM. Pelletier and Cavantou employed alcohol acting upon the substance of plants; but I found that when leaves were to be operated upon, it was necessary to boil them previously in ether, to remove the wax and oily matters which they almost always contain. On treating yellowed leaves of the poplar (*Populus fastigiata*), with boiling sulphuric ether, it was slightly coloured yellow, and deposited, on cooling, a pulverulent substance, having all the properties of wax. By evaporation, there was obtained a white, solid, fat matter, fusible at a low heat, of a strong poplar smell, and exhaling an acrid and pungent vapour when heated. This substance is equally found in the green leaves. The residuum of the yellow leaves was boiled in a sufficient quantity of alcohol at 40°, which was tinged of a beautiful yellow hue, and the leaves lost their colour. This alcoholic solution, on being mixed with water, does not at first render it turbid; but there presently separate yellowish flakes of a resinous appearance. If, after mixing it with a little solution of alum, there is added pure potash, a beautiful lac of an orange colour is precipitated. Evaporated at a gentle heat, the alcoholic solution of the yellow leaves deposits a solid substance of an orange-yellow colour, and herbaceous taste, translucid, becoming agglutinated together when warm; soluble in ether and alcohol, which it colours yellow, insoluble in cold water, and dissolving a little with the aid of heat in diluted acids. When acted upon by fire, it melts and bubbles, then emits a pleasant smell, like that of burnt vegetable matter. Heated in diluted nitric acid, the yellow matter intumesces, and then dissolves, leaving a residuum of a yellowish-white colour, which, on being treated with water, gives no indications of the presence of oxalic acid. All these properties are common to it with the green substance extracted by the same processes, from the yet green leaves of the same tree, with modifications of colour only. The differences which these two matters present are, the solubility in the fat and essential oils of the green matter, and the insolubility of the yellow resin in these same menstrua, and the action of acids and alkalies. In fact, a prolonged abode, even in the cold state, of the yellow resin in the alkalies, brings it back to a beautiful green colour, and the action of heat accelerates this effect. It is then in all respects similar to the chlorophyle, and becomes, like it, soluble in oils. On the other hand, all bodies capable of yielding their oxygen, as acids, or the employment of means which facilitate the combination of that gas, as the exposure to the air of the alcoholic solution, heat, &c. make the chlorophyle pass to the yellow or red colour; so that the resin of the leaves which have undergone the autumnal colouring, seems to be nothing but green resin oxygenated, or having undergone a kind of acidification.

If a yellow leaf of any tree whatever is allowed to remain some time in potash, it becomes of a beautiful green, without experiencing any sensible alteration. Ammonia, and all the alkalies, produce the same effect. On the other hand, when a green leaf is left in an acid, it becomes yellow or red, and potash restores the green colour, &c. It were impossible to retain the name of chlorophyle for a substance, which not only is not always green, but which, as I have just said, exists elsewhere than in the leaves, and I had imagined the word *phytochrome*, when M. De Candolle, to whom I communicated these results, informed me, that he had also felt the propriety of adopting a new word, and had made choice of the term *chromule*, which I shall employ in what remains of this memoir.

If the reddened leaves of Rhus coriaria, or the pear-tree, are treated with boiling alcohol of 40°, the liquor is coloured of a fine blood red, and, by evaporation, deposits a resinous substance, which becomes of a fine green by the action of alkalies. An acid, in this case, restores the red colour. As the green chromule is frequently seen to pass through the yellow hue, before arriving at the red, we might naturally conclude that the latter is at a higher degree of oxygenation. There results from these facts, that the autumnal change in the colour of the chromule of the leaves might easily be explained by the fixation of new doses of oxygen, which would continue to be absorbed without being exhaled. This addition would produce successive alterations of colour, without affecting any great change in the other properties of the chromule. This would easily explain the phenomena presented by certain leaves, as those of *Arum bicolor*, which exhibit the three colours, red, yellow, and green, at once; those of the *Tradescantia discolor*, which present a beautiful red colour at their under surface, while the upper is green; and there may, in fact, be obtained from these different parts, chromules of different colours, the yellow and red passing to green by the action of potash, &c.

Having found that the colouring part of the leaves might, with very slight modifications, present the varied tints of green, red, yellow, and their mixtures, it became interesting to find out whether, agreeably to the analogy which the observations of botanists have demonstrated between the various organs of plants, such as the leaves, the calyces, the corollas, and their appendages, the same colouring principle that was met with in the leaves might also be found in the flowers.

It was at first easy to find in the calyces the green chromule, such as it presented itself in the leaves; and, on taking as a medium the coloured calyces of *Salvia splendens*, I obtained from them, by means of alcohol, a substance of a beautiful red colour and resinous nature, having all the characters which the chromule of reddened leaves presented to me. Like these leaves, it was rendered green again by the alkalies, became red a second time by the addition of an acid, was insoluble in oils, &c. Passing to the petals of the flowers of *Salvia splendens*, and the portion of the stem which supports the flowers, and which is red like them, I found the same product. The petals of red geraniums, Bengal roses, asters, &c. treated by the same means, all yielded, as their colouring principle, the red chromule, and the flowers remained semitransparent and colourless. All the yellow flowers which I examined also presented a chromule of that colour, which was rendered green again by alkalies, &c.

The white flowers, the small number at least which the advanced season permitted me to procure, appeared to contain a slightly yellowish chromule, modified in its colour by some natural process, which it would be necessary to examine afterwards. The reddish-blue flowers, such as those of the stock-gilliflower, yielded a tint, at first rosy, then purplish, and leaving a residuum of a fine violet colour. The flowers of a blue sweet violet (*Viola odorata*) gave, in the same manner, a substance of a fine blue, not unlike the preceding. This substance was rendered green by alkalies, reddened with acids; was soluble in cold water; and might be kept in a state of powder, were it wished to preserve the colour of violets. As it might be supposed to be the result of the combination of the red chromule with a vegetable alkali, I tried to imitate it by a factitious combination of the same kind. I triturated, with a small quantity of vegetable alkali, as quinine, strychnine, &c. the red chromule obtained from leaves of that colour; and I found that this mixture had become soluble in cold water, had no longer the resinous appearance of the red chromule, and assumed a bluish-green tint, as decided as I could have ventured to expect from an experiment imitating the natural processes so widely. This mixture reddened with the acids, and became bluish by means of the alkalies, precisely in the same manner as the vegetable blue tincture would have done. Ammonia in vapour also gives a bluish tint to the red chromule; but by heat and exposure to the air, the gas evaporates, and the red colour re-appears.

From these facts, I think it may be concluded, that the blue and violet flowers have, for their colouring principle, the red chromule united to a vegetable alkali. This conclusion I shall try to corroborate by analysis, as soon as the season will allow.

I had occasion, last spring, to examine different varieties of *Aquilegia vulgaris*, unfortunately before engaging in the experiments which form the subject of this memoir. This flower, which is naturally blue, easily varies to red, by passing through the intermediate tints. The blue and red flowers, treated separately, whether with water or with alcohol, presented tinctures, assuredly neutral, and perhaps even alkaline in the first case, and decidedly acid in the second. I even found it to be acetic acid that the red flowers had yielded to the fluids employed.

From a review of the facts mentioned above, I think there may be deduced the following conclusions:

1*st*, All the coloured parts of vegetables appear to contain a particular substance (the chromule), capable of changing colour by slight modifications.

2*dly*, It is to the fixation of oxygen, and to a sort of acidification of the chromule, that the autumnal change of the colour of leaves is owing.

# *On the Value of the Evidence from the Animal Kingdom, tending to prove that the Arctic Regions formerly enjoyed a milder Climate than at present.* By the Rev. JOHN FLEMING, D. D. F. R. S. E. (Communicated by the Author.)

IT was long a favourite opinion among naturalists, that all the species of animals or vegetables, which the Omnipotent Creator ever called into being, still remain the inhabitants of this globe, independent of the dangers to which they have been exposed, or the changes which have taken place in their geographical distribution. The difficulties which attended the acknowledgment of this opinion, arising from the number of singular forms found imbedded in the regular strata, or distributed among the loose materials on the surface of the earth—forms indicating species which the neighbouring districts did not possess—were conceived to be in a great measure removed, by the supposition, that unknown regions might yet exhibit living examples, in addition to many species of which the naturalist had obtained no information. In proportion, however, as the progress of geography extended our acquaintance with distant regions, and failed to furnish the requisite examples, the opinions of naturalists experienced a corresponding change. The ancient creed was at length abandoned; and no one, acquainted with the subject, refused to acknowledge, that in the earth were preserved the relics of numerous species which have no longer a place among the living on this globe.

The characters of the extinct species, after this change in public opinion, presented to the philosophical observer an extensive field of research and speculation. Prevented now from expending his resources, in seeking out the dwellings of animals which no longer exist, his attention was directed to the characters of those extinct species, the relics of which the strata had preserved, with the view of tracing their relations with the living tribes. The bones of the mammoth, occurring in the loose strata, were speedily identified with those of an elephant. The shells and corals of the older strata were exhibited, as resembling the productions of equatorial seas; while the impressions of vegetables, found in the shale of our coal-fields, were traced to be analogous to the productions of tropical forests. The conclusion seemed to be warranted, by an extended induction, that our region once enjoyed a tropical climate, at which time our rivers were swarming with alligators, our lakes with tortoises, and our seas with corals; when our caves were the haunts of bears and hyænas, and our forests the resort of the elephant and tiger. Nay, that in those northern regions, now suffering, during so great a part of the year, all the rigours of an iron winter, the climate was once so mild as to permit the residence of the rhinoceros and the elephant.

Imposing as these conclusions certainly appear, their validity might, with propriety, have been called in question, when naturalists, ceasing to rely on general appearances, examined more narrowly specific characters, and announced, as a result of their labours, that the extinct animals, though generically related to the tropical kinds, were yet to be viewed as *distinct species*. The argument in favour of a *change of climate*, which these fossil remains formerly seemed to furnish, now unsupported by observation, was found to rest entirely on analogy. Yet, in spite of this change of character, it is still relied on with confidence, as yielding support to hypothetical views; and few geologists of eminence could be mentioned, in whose writings it has ceased to occupy a prominent place. Some anxiously seek for proofs of a change of climate, on the supposition that our planet was once fluid by heat, and is still in the act of cooling; while others, guided by their notions of magnetism or electricity, are equally sanguine in their expectations of perceiving proofs of change *.

If it be admitted that the extinct animals are different *in species* from the existing kinds, and here, we presume, there is no difference of opinion, we shall be able to bring the subject into that form in which accurate conclusions may be obtained, or the value of those previously announced brought to a suitable test. Indeed, the whole argument in favour of a change of climate seems to depend on the value of *analogy*, as an instrument of research. Supposing ourselves acquainted with the habits and distribution of one species of a genus, can we predicate, with any degree of safety, concerning the habits and distribution of the other species with which it is generically connected? Geologists ought to have investigated this preliminary question with care, before they commenced their speculations. Instead, however, of acting with such caution, they have assumed that the question may be answered in the affirmative; or rather, it does not appear that they were aware of any difficulty in the case, or conceived for a moment that their regulating principle might have no higher authority than a *petitio principii*.

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* Professor Link in his Urwelt, or Antediluvian World; Kruger in his History of the Antediluvian World; and other modern writers on geology, oppose the opinion of Cuvier, and advocate the view discussed by Dr Fleming in this memoir.—EDIT.

Geologists, it is true, were countenanced, to a certain extent, in reposing confidence in *analogy* as their guide, by the authority of the most zealous, enlightened, and successful comparative anatomist the world ever possessed, Baron Cuvier. Successful in the employment of this instrument, in several instances, assisted, however, by numerous observations, this anatomist, under the influence of prejudices which few can avoid, has stated his confidence in the certainty of its deductions, with a boldness, which is the more astonishing, as it is equally at war with his own admissions and well-known facts. "Any one who observes only the print of a cloven foot, may conclude that the animal which left this impression ruminates; and this conclusion is quite as certain as any other in physics, or in moral philosophy."—*Recherches sur les Ossemens Fossiles*, i. 51. Observation had discovered many animals with cloven hoofs which ruminated; but, in such circumstances, would it be safe to infer that all cloven-hoofed animals ruminate? Conceive ourselves contemplating the footmarks of a sheep and sow. Under the guidance of Cuvier's declarations, we would conclude that both ruminated,—an inference true in the one case, and false in the other. Observation here warns us against the employment of a guide so liable to deceive us. But this charge against analogy may perhaps appear in greater strength, after the reader has perused the solution of the following questions.

1. *If two animals resemble each other in structure, will their habits be similar?*—If this question could be answered in the affirmative, it would greatly heighten the interest which is attached to the study of fossil remains, by giving to our observations an authority which at present they do not possess. The

comparative anatomist has traced a considerable resemblance between the skeleton of the hippopotamus and the common ox. No analogy, in this case, would have led the enquirer to form even the slightest suspicions respecting the existence of those aquatic habits of the former animal, which constitute so singular a feature in its character. Let us place on a table the skeletons of the ermine, the polecat and the otter, and the general resemblance of these to one another would at once be admitted; and, confiding in our *analogies*, we might pronounce their habits to be similar. Observation, however, would convince us that these three species were different in their habits and propensities, though included by Linnæus in the genus Mustela. The common bear and arctic bear exhibit equal resemblances of structure, and equal differences of habit. These facts, and multitudes of the same kind which might be produced, intimate the propriety of relying on analogy with caution, in all those cases to which our observation does not extend. The skeleton of the hippopotamus could not give any intimation of the diving powers of the animal, nor would the bones of the feet of the otter lead to the supposition of its having webbed toes. Osteology, indeed, gives but very imperfect indications, even of external form, in many animals. Would the round caudal vertebræ of the seal indicate the depressed tail of the animal, or the depressed bones of the face in the whale indicate the remarkable fulness of the outline of its head? We may agree with Cuvier in supposing that the mastodon had a proboscis like an elephant (to enable it to procure its food from the ground), from the general resemblance of the two animals in structure, from the length of its legs, and the slight development of the toes. But when we remember the giraffe, with its head proportionally farther removed from the ground than the mastodon, able to provide food without a proboscis; and the hippopotamus and the dipper (*Cinclus aquaticus*), which are excellent swimmers, though seemingly ill suited for the exercise, we will view the conjecture in no other light than a probability, and not remarkably strong.

2. *If two animals resemble each other in external appearance, will their habits be similar?*—It is seldom, indeed, that two animals resemble each other in all their organs, so very closely, as

to render it difficult for the attentive observer to discriminate species. Some modifications of form and structure usually occur in the one species which cannot be perceived in the other, and which serve to influence its habits. But even in those cases where approximations of form are the closest, do we perceive a similarity of actions? If this were the case, the study of Natural History would be comparatively easy, as the field of observation would be reduced within accessible limits. The truths of zoology, however, forbid the indulgence of such expectations. The habits of each species must be studied as a separate subject of investigation, permitting analogy to assist, but in no case to guide us. The examples to justify this statement may be taken from any one of the classes of the animal kingdom. The common shrew frequents old walls and dry grassy banks; while the water shrew dwells on the margins of ditches, and swims and dives with ease. The common mouse, the pest of houses, itself improvident, seeks after the storehouses of men; while the field mouse frequents gardens and fields, and is not only a storing animal, but susceptible of torpidity. How different the solitary or pairing habits of the porpess, from the gregarious wandering grampus. In birds, the same difference of habit accompanies generic resemblances. The rock-dove builds its nest in caves, (and hence the plan of dovecots), and delights to rest on a grassy bank; while the ring-dove frequents the forest, resting and breeding on trees. How dissimilar in habit the rook and the jack-daw, the heron and the bittern? Equally different the char, the sea-trout and the common trout. Whether we contemplate *species*, in reference to their food, their haunts, their protection against foes, or the method of rearing their young, we find each exhibiting peculiarities of which a knowledge of the habits of its congeners would not have given us the slightest intimation.* But a third subject of inquiry yet remains to be investigated.

3. *If two animals resemble each other in form and structure, will their physical and geographical distribution be similar?*—Nearly the same anomalies present themselves, when considering animals in reference to their stations on the globe, as when view-

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* The reader will find some other illustrations of this subject in my "Philosophy of Zoology," vol. ii. p. 88.

ing them in their relations to their habits. Every species has its own appointed place, influenced in all cases by latitude, and even sometimes by longitude. The zebra delights to roam over the tropical plains, to which it is in a great measure restricted; while the horse can maintain existence even throughout an Iceland winter. The buffalo, like the zebra, prefers a high temperature, and cannot thrive, even where the common ox prospers. The musk ox, on the other hand, though nearly resembling the buffalo, prefers the stinted herbage of the arctic regions, and is able, by its periodical migrations, to outlive a northern winter. The chacal (*Canis aureus*) inhabits Africa and the warmer parts of Asia; while the isatis (*Canis lagopus*) resides in the arctic regions. Species of the genus felis likewise inhabit every climate, each limited in geographical distribution. The African hare and the polar hare have their geographical distribution expressed in their trivial names. Ornithology might be called on to furnish examples equally illustrative of the question under discussion. The red grous is confined to the United Kingdom in its geographical distribution, and is a bird which we may consider as peculiarly our own; while the ptarmigan has a range of dwelling, extending to the higher northern latitude of 74°.

The resources against the vicissitudes of the seasons, appear to exhibit equally remarkable differences according to the species. Thus, while the grous braves, unchanged in colour, the rigours of our winter, the ptarmigan assumes a white plumage: while the favourite redbreast spends his winter almost under our immediate protection, the nightingale betakes herself to a warmer climate. The yellow bunting remains with us throughout the year; the snow bunting only visits us in winter, and retires to spend the summer, and rear its young, on the rocks of Greenland.

From the preceding statements, which might have been extended to an almost indefinite length, the conclusion appears unavoidable, *that every species is controlled by its own peculiar laws*, and that no acquaintance with one species of a genus, however extensive and accurate, warrants us in predicating concerning the habits and distribution of any other species, even though very striking resemblances in structure and form may prevail. What, then, is the amount of the argument, leading to the belief that the arctic regions once enjoyed a milder climate than they now possess, derived from the relics of animals found imbedded in the soil?—Remains of an elephant and of a rhinoceros have been found in Siberia! These animals at present live under a warm climate; and when Siberia was peopled by such animals, its climate must have been much milder than in the present day!—If the relics of the elephant and rhinoceros, found in Siberia, belong to the *same species* which now dwell in equatorial regions, we must either suppose that they were transported to their present tomb, or, if they were the denizens of the country, that the climate of Siberia has greatly changed. In such circumstances, our conclusions would be supported by the truths of science, for, in reference to the *individuals of a species*, our knowledge of the ordinary habits and distribution of a few of these qualifies us for judging respecting the remainder*. If, however, it shall be found that the relics of the elephant and rhinoceros of Siberia belong to *species different from those which now dwell in tropical forests*, our speculations must change their character; for the truths of zoology forbid us to reason concerning the *species of a genus* in the same manner as we do with the *individuals of species*; and all our prejudices, associated with the *names* we use, must be dismissed from the mind.

Viewing, then, the Siberian elephant and rhinoceros as different *in species* from those which we conceive peculiarly fitted to reside in a tropical climate, and the proof of this difference has been satisfactorily established; our conjectures respecting their original condition must be conducted on widely different principles. If still unwilling to allow that these species ever resided in Siberia, but inclined to consider them as having been conveyed by some current of water from another and warmer region, we have to determine the locality of their residence at the very outset of our speculations. Now, these species no longer occur in a living state, in any region of the earth. Their former geographical distribution can be inferred only by the dispersion of their bones. These relics occur very frequently in the north of Europe, Asia, and America, in the higher latitudes, become scarcer as we proceed towards the south, *and do not occur within the geographical limits of the existing races.* It is vain, therefore, to have recourse to diluvian transportation, when we cannot point out the place from whence they may have been brought. If we admit that these extinct species lie buried in those very regions in which they formerly resided, and the whole circumstances of the case warrant the conclusion, what are the inferences which we may legitimately deduce? That as these species appeared to have lived in Siberia, they consequently must have possessed habits suited to their geographical distribution. This is reversing the ordinary notions on the subject; for, instead of suiting the climate to the species, we consider the species as suited to the climate. Nor are we left in doubt on the subject. The museum of nature has furnished us with a specimen to which an appeal can be made. The entire *carcass* of a Siberian elephant, or mammoth, as it is termed by the Russians, was found about twenty-two years ago, by Mr Adams (the bones of which form the skeleton in the Museum of the Imperial Academy at Petersburgh), preserved in *ice*, near the mouth of the river Lena, on the shores of the Frozen Ocean. Did the skin present externally that thinness of hair, scaliness of surface, and naked appearance, which characterize the living elephants of the equatorial regions, or did its condition, as to hair, indicate an animal fitted, by its clothing, to reside in a cold climate? The covering was of three kinds:—*bristles* nearly black, much thicker than horse hair, and from twelve to sixteen inches in length;—*hair* of a reddish-brown colour, about four inches in length; and *wool* of the same colour as the hair, but only about an inch in length. Though much of the fur was lost, upwards of thirty pounds weight were gathered from the wet sand bank. Here, then, is a demonstration, that the

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* Sir Everard Home has, it is true, attempted to prove the identity of the Siberian and African rhinoceros, by considering the skull of a recent individual, brought by Mr Campbell from Mashow, in South Africa (and which occupies a place in the museum of the London Missionary Society, and is recorded in the catalogue, p. 10.), as having a perfect resemblance to those of the Siberian species.—*Phil. Trans.* 1822. In the twenty-second number of the Edinburgh Philosophical Journal, I intimated my suspicions of the accuracy of this opinion, founded on the great difference in the physical and geographical distribution of the two animals; and the inquiries which I made in London, in the spring of the following year, justified the view which had been adopted. Baron Cuvier's inquiries, about the same time, led to a similar conviction, that the celebrated London anatomist had been betrayed into error, by a too hasty and superficial examination of the specimen from Caffraria.—*See Cuvier, Oss. Foss.* iv. 493.

Siberian Elephant was not, from the abundance of its clothing, fitted for a warm country, but destined for a dwelling of an opposite character. In other words, that the Siberian elephant was fitted for braving the severity of a northern climate, and that at the period in which this individual died, there was freezing taking place in Siberia, much after the same manner as at present. To form an accurate conception of the Siberian elephant or mammoth, we must not imagine an animal naked, like the African or Asiatic species, but enveloped in a shaggy, thick covering of fur, like the musk ox, impenetrable to rain or cold. The carcass of the Siberian rhinoceros, found on the banks of the Wilhoui, in 1770, by Pallas, gave similar indications of its hairy covering being suitable to an arctic animal.

Perhaps there may be some readers, irritated at the overthrow of a favourite hypothesis, ready to offer the following objection. How could such animals, as the elephant and rhinoceros, find means of subsistence in the northern regions, which are so scantily supplied with herbage? There is no difficulty in conceiving the elephant capable of securing food, when we know that many of our largest quadrupeds at present people those regions; such, for example, as the musk ox, the moose deer, and the bison. The kind of food these ancient elephants employed, will probably never be ascertained, and we do not possess the means of forming even a feasable conjecture. We may know the kind of food the existing species prefer, but this yields no aid in determining the taste of the extinct species. Who is there acquainted with the gramineous character of the food of our fallow deer, stag, or roe, that would have assigned a lichen to the rein-deer?

Yet, reluctant to admit that Siberia was once peopled by elephants, the reader may be disposed to ask, how could such animals outlive the winter? This question can only be answered by a reference to the history of animals in similar circumstances. The modern northern animals *migrate*, and we entertain little doubt that the Siberian elephant was equally disposed to the shifting of place, with the changes of the season.

Those who have been misled by the prejudices connected with the names *elephant* and *rhinoceros*, and in consequence have conceived the climate of Siberia to have been warm of old, to suit their supposed tropical animals, may yield to the force of the preceding arguments. Those, however, who imagine that our earth is red hot at the centre, as it was formerly at the surface,—that the period is not long passed by, since the crust became so cool as to allow *climate* to operate, will be inclined to retire from the untenable outpost, formerly occupied by the mammoth, to the more inaccessible strongholds of our lime quarries and coal-pits. The strata, accompanying our coal metals, abound, say they, with the impressions of plants, which do not resemble the modern productions of our country. In order to find analogous forms, we must betake ourselves to warmer climes, and trace in the reeds, the palms, and the ferns, reared under a tropical sun, species resembling those relics which the older strata have preserved. And, if the fossil plants resemble tropical species, is not this a proof that our climate once resembled a tropical one? Two things very different are here confounded. Our fossil plants may resemble tropical plants; but if they are not *individuals of the same species*, the data which they furnish, however useful in tracing *affinities* of form or structure, furnish no clew whatever for determining geographical or physical *distribution*,—for it is with plants as with animals,—we may reason safely concerning the individuals of a species, but not concerning the habits and distribution of one species, from our knowledge of the characters of any other species of the genus to which it belongs. This country, cold as it is, may have had its palms, its cacti, and arborescent ferns, under a temperature similar to the present, due regard being had to species, not genera; for, at a comparatively recent period, and within the shade of the genealogical tree of our existing quadrupeds, Britain possessed an elephant, a rhinoceros, a hyæna, and a tyger.

MANSE OF FLISK,
*7th February* 1829.

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# *On the Establishment of an Invalid Depot in the Himalayah Mountains; being an Extract from a Letter addressed to Sir* JAMES *M'*GRIGOR, *Director-General of the Army Medical Department.* By Dr WILLIAM BURKE, Inspector-General of the Hospitals of the King's Troops in India. Communicated by Sir JAMES M^c^GRIGOR.

[The following document contains a statement of great importance to Europeans in Bengal, and even to those who take an interest in the health of our troops and friends in that part of the world. It communicates the account of a district, with a climate of such a nature as will render it unnecessary for invalids to seek health in Europe, and thus enable them to remain in India to finish their period of service. To our troops, the importance of such a climate requires no comment. We understand that a district equally favourable for the recovery of health has been discovered in the Madras Presidency. It is on a table-land thirty miles in extent, in the Neelgherry hills, between the Malabar and Coromandel coasts. To this district, those invalids formerly sent home to Europe are now removed for the recovery of their health. A similar favourably situated spot has been lately met with to the northward of the Bombay Presidency, whither invalids are to be sent *].

I HAVE now the pleasure of communicating to you a copy of a document which is very interesting to the service, as confirming all that had been hoped from, and predicted of, the establishing an invalid depot in the Himalayah. By this report of a special committee, of which the superintending surgeon of the district (Merut) was president, the advantages to be derived from it are so evident and confirmed, that I should think it will be, or rather must be, established by the sanction and authority of government. Landour, the site of this sanitory depot, is a part of the elevated range of the Himalayah mountains, which rises above the Deyrah Doon. The centre part of this range, called Mussooree Tibi and Landour, has for some years been resorted to by invalids: houses were erected there by them, and an experimental physic garden for rhubarb, &c. established. It enjoys a delightful climate, presenting as great a degree of equability of temperature from summer to winter, and from day to night, as can be desirable. In summer, the temperature is low, and all accumulation of heat is prevented by the coolness of the breeze which ascends from the valleys. The transition to the rains makes hardly any difference in the temperature; and though the weather is gloomy occasionally, it is pleasant and healthy. In the month of October, or at the conclusion of the rains, the sky is so clear, the air so mild and still, that the climate is said to be perfectly delightful. This clearness and purity of the atmosphere continues throughout the months of October and November. The approach of the cold is so gradual, and its degree so moderate, as to be well calculated to brace the system, when improved by a previous residence among the hills.

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* A pamphlet has just been put into our hands, entitled "A brief Dissertation on the Climate of the Hill Provinces, as connected with Pathology. By Julius Jeffreys, Member of the Royal College of Surgeons of London, Assistant-Surgeon to the Honourable East India Company," published at Calcutta in 1824. The author, after an interesting discussion as to the nature of the climate in these elevated districts, strongly recommends the sending of invalids to the hill provinces, and maintains that their climate is more favourable to Indian invalids than that of Europe.

The eligibility of this climate for restoring to health Europeans labouring under diseases induced by a residence in India, is not now fortunately so much a problem to be solved, as an inference to be drawn. The hills have been visited for several years for the recovery of health, and the Mussooree range has been resorted to for the last four years, during which time individuals of both sexes have resided there during the hot season and rains, and all speak in raptures of the delight they experienced, and the recovery the invalids had.

In the selection of the cases of invalids of his Majesty's service to be sent to the sanitory depot, some consideration was required on the nature of the diseases which were likely to be benefited by the climate. The diseases most prevalent in India, such as fevers, dysentery, liver complaint and spleen (where there was no serious structural disease in the two latter), with the cases of those who at the conclusion of the rains particularly suffer from a suspension of the functions of the liver, and a torpid state of the viscera, as well as of others who are well in the cold season, and invalids in the hot, would, I should think, be cured, and the most aggravated cases alleviated at least, by a residence in the climate. As pulmonary complaints are, it appears, endemic in the place where the action of the lungs must be increased from the rarity of the atmosphere, it would not be wise to send them to such a climate, although the alleviation they might obtain in the change from the heat of the plains for a short period, might be thought to render it humane. However, as much was at stake in the success of the first attempt at the establishing an invalid depot in the hills for his Majesty's forces, I communicated my ideas on these subjects in a letter to the surgeons of King's regiments, from which the invalids were to be selected, of which I formerly inclosed you a copy.

The time necessary to remain on the hills, must of course depend upon the nature of the case; but a residence of eight months (that is, from the beginning of March to the end of October) may probably suffice for the generality of cases; and this, with the subsequent and previous four months of the cold season, will give the patient an uninterrupted sixteen months of cool weather. But in a rigid comparison of the powers of a hill and European climate, in *radically* curing the most aggravated cases of Indian disease, it will be necessary to give to both an equal quantity of time to produce their respective effects. In the selection of a convalescent post, the elevation of 6500 feet was deemed indispensable, it giving a mean temperature of about 55°. Three or four hundred feet higher or lower may depress or elevate the thermometer one degree. The top of the range will enjoy the most equable temperature, and if, at the same time, at the head of a valley, there will be generally a cool breeze in summer; but there are sites on the northern and southern sides of the ranges, that afford shelter and warmth, and the contrary, as to summer and winter. But the general temperature of Landour is so equable, that these considerations are not so material as they may be elsewhere. The part of the range to which the name of Mussooree is more especially applied, being already occupied with bungalows, it was necessary to erect the invalid buildings at Landour, a continuation of the range, and in fact preferable to Mussooree, from which it may be distant by the *road* in an easterly direction about a mile and a half: its direction is east and west. The extent of ground, its openings, and elevation, pointed it out as well or best adapted for the purpose. The elevation of Landour above the houses at Mussooree is 780 feet; and its height above the level of the sea may be about 7600 feet: there is a difference among the engineers of 150 feet.

The top of Landour is covered with oaks and Rhododendra, and the sides of the northern face with the *Pinus longifolius*. The peak is composed of hard quartzy sandstone: below this, the sandstone is of a more granular texture, and easily separable into masses for building. Clay-slate is, however, the predominant rock, and some has been discovered fit for slating the houses. Limestone is abundant below the granular sandstone, and in its vicinity heavy-spar. The springs of water are plenty, and perennial, and sufficiently near to afford an abundant supply for every purpose, with the aid of mules and pukals. By confining the water of the higher springs in cisterns, great abundance of water will at all times be obtained, and at a very short distance. But at 6000 feet elevation, there are at all seasons considerable streams of water.

It is well known that the climate of the Mussooree range is as equable throughout the year as that of any other cold climate; that it is easily and equally accessible at all seasons of the year, and that the situation combines in itself a sufficient number of other advantages to make it the most beneficial residence for invalids. Landour is in Latitude 30° 26½′ N., and Longitude 78° 4′ E. The mean temperature of the year is 54°.92; the mean temperature of April, 54¾°; May, 55°; June, 67°; July, 67°; August, 66°; September, 63°; October, 61°; November, 52°; December, 45½°; January, 42°; February, 42½°; March, 53°; and there is great equability of temperature during the day and night.

The vegetation is vigorous, and resembles the luxuriance of the garden rather than the rankness of the jungle. Potatoes, carrots, cabbages, cauliflower, onions in great perfection, beet-root, nol kol, salads, &c. grow here; and, by proper cultivation, and taking advantage of the northern and southern aspects, a succession of many of these may be had throughout the year, and their cultivation be a source of great pleasure and health to the invalids.

Poultry thrive remarkably well; excellent hill mutton and cattle are easily procured; goats and pigs are numerous. The European fruits, as apples, apricots, cherries, pears, currants, raspberries, barberries, strawberries, &c. are abundant. Deer and antelopes, pheasants, partridges, and the jungle fowl, are plentiful.

Of the men who were sent to the sanitory depot, it appears that the greater proportion are now free from disease, and are in fact become robust, and the convalescence will be still more universal towards the commencement of the cold season in November, when it will be attended with no farther practical or experimental advantage to the service to retain them longer on the hills. Mr Cathcart says it is a source of happiness impossible to describe, to witness the amendment which appears to have taken place among the troops, especially since they were housed just before the rains. The only cases which it is to be apprehended will be permanently found to be of difficult cure, are the chronic spleen cases of the Honourable Company's European Regiment, with one or two of the Artillery who had been at Chedubа and Rangoon, and the rheumatic cases (with syphiloid symptoms) of his Majesty's 31st Regiment, and one patient who has had two abscesses ruptured in his lungs, and must die. Good effects in their cases are, however, to be anticipated from the frost and snow. These invalids will have to remain there throughout the *winter*, which is much milder than an English winter, and also such of them as may not be sufficiently recovered to be removed by the time that the cold season sets in on the plains.

The experiment hitherto has had so little fair play (owing to unavoidable circumstances), and the period has been of so short a duration (since April last), that at first one could have scarcely ventured to pronounce an opinion on its ultimate success or failure. But from the official facts recorded in the report of the special committee, it seems now established that its advantages cannot be longer doubted, so that the most fastidious cannot have a plea for throwing obstacles in the way of its becoming a permanent depot. It will be attended with more extensive and permanent benefit than any institution ever established in this country, upon a principle of humanity, as well as of the mercantile principle of gain; and it will most amply repay the government in a twofold manner.

HEAD QUARTERS, SIMLA, }
*July* 23. 1828. }

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## *Observations on the Natural History of the* Chamæleo vulgaris, *or Common Chameleon.* By ROBERT SPITTAL, Esq. Member of the Plinian Society, &c. Communicated by the Author *.

THE singular habits of the chameleon have ever excited popular astonishment, and from their peculiar interest, claimed in a high degree the attention of the natural historian; and though it be now some time since, through his aid, many singular, but erroneous conclusions, concerning the nature and habits of this animal, have been dissipated, still we trust that the few remarks we intend to make, from personal observation—having had two of these animals in our possession for several months some time ago—will not be deemed unworthy of attention.

That the particular species to which our observations apply, may be identified, we may mention that it is designated by Baron Cuvier, in his *Regne Animal*, "Le Caméléon ordinaire." It is a native of Europe, Asia, and Africa. Those in our possession were brought from the south of Spain, and measured about five inches in length, exclusive of the tail. On being touched, they conveyed an impression of cold to the hand, and, like other cold-blooded animals, were very sluggish in their motions; and, indeed, we have frequently observed them remain in the same posture, for hours together, firmly embracing the twig on which they stood, with their toes, having at the same time, the tail generally twisted around the same, or some adjacent twig.

When excited to motion, by the appearance of a fly, not within the range of their power, or otherwise, they proceeded very slowly from branch to branch, moving first one extremity, then another, at the same time securing themselves by their tails; and we have often observed them trust entirely to this organ, when descending from twig to twig, and sometimes been impressed with the similarity between their motions and those of some of the monkey tribes, having prehensile tails.

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* The *Agama* and *Polychlorus*, like the Chameleon, display, according to circumstances, various beautiful colours. Even the *deep black* colour at times assumed by the Chameleon, occurs also in these creatures.—EDIT.

Sluggish though the chameleon generally be, there are particular organs which form eminent exceptions to this general remark, and this is particularly the case with the eyes. These organs, except when the animals were asleep, were used with great alacrity; and it is no exaggeration to say, that they were continually rolling in all directions, with the singular peculiarity of each eye having an independent motion, as mentioned by Cuvier and others. This fact we have frequently observed; and it was not an uncommon thing to see one eye directed upwards, and the other downwards; or one backwards, and the other in an opposite direction, at the same time. Thus, in a beautiful manner, one function is made to compensate for the want of another; for, though naturally sluggish in the motion of its body generally, it enjoys a more extensive sphere of vision than any other animal in similar circumstances; and is thus enabled to discover its prey over a much larger surface, than, did it not possess the extensive motion of its eyes mentioned, it otherwise could.

They lived entirely upon insects, and these were tempted to approach by besmearing the twigs in the cage with honey. On observing one—which was easily known by their keeping one or both eyes stedfastly fixed on it for a short time—the method of attack pursued was to the following effect. They slowly moved towards their prey, as if afraid to disturb it; at the same time keeping their eyes firmly fixed upon the insect until within a few inches of it, then on a sudden darting forth the tongue, and as suddenly withdrawing it, they secured their prey, which very voracious mastication and deglutition soon disposed of.

The greatest distance to which we have observed the tongue protruded, was about five inches, generally less, never more. This organ, protruded by strong muscular power, is, we believe, chiefly returned to the mouth by an apparatus attached to its base, which acts by its resiliency, in a somewhat similar way to the elasticity of a silk purse, when drawn out, and suddenly let go. The better to enable them to seize their prey, the extremity of the tongue folds up to a slight extent, somewhat like the extremity of the proboscis of an elephant; and moreover the organ is coated with an adhesive matter.

According to the quantity of air in the lungs, the lateral dimensions of the chameleon are more or less extended. We have observed them more than an inch and a half in breadth across the chest; sometimes, however, compressed to less than half an inch; their usual bulk was the medium between these.

That the change of colour has an intimate relation to the bulk of the animal, or, in other words, to the quantity of air in the lungs, there is every evidence; and we shall now make a few remarks on that singular phenomenon, stating the various changes of colour observed, and at the same time the circumstances in which the animals were placed at the moment. To communicate a knowledge of the particular shades of colour noticed, we shall refer to the nearest in Werner's "Nomenclature of Colours," by Syme. The usual colour observed during the day, was a mixture of various shades of green, in irregular spots; towards the head, these, however, sometimes assumed the form of stripes. The following are the numbers of the shades of green according to Syme, which approach nearest to those we noticed, viz. Nos. 46, 47, 48, 51, 52, 53, 54, 57, 58, frequently intermixed with nearly all the shades of grey given by Syme. Sometimes these colours were slightly mixed with yellowish patches, approaching to No. 71; at other times, with dark purple spots, rather lighter in colour than No. 96.

Such were their usual colours for the most part of the day, while moving about, undisturbed in their cage, or amongst the twigs of a plant, in the search of food. When of the greenish hue mentioned, it was sometimes difficult to discover them amongst the leaves; and indeed it seems probable that this may be a provision of nature, to enable the chameleon to procure its food, which consists chiefly of insects; and these, had the animal been of a colour more distinct from that of its natural habitation, trees, might have been deterred from approaching within a tangible distance.

At night, when asleep, the colour was of a yellow hue, approaching to Nos. 71, 75, and 63, at different times. Being desirous to ascertain the effect of light on them, while of that colour, we placed, for this purpose, a lighted candle, about three or four inches from the side of one of these animals, and allowed it to remain for a few minutes, the effect of which was, that light brown spots (No. 105.) began to appear, at irregular distances, on the side next the light. These spots gradually deepened in colour (No. 104), until they attained that of a dark brown (No. 103.) On the removal of the light to a distance, the spots as gradually disappeared, and the animal assumed its usual yellowish hue.

A similar effect took place on imitating a shower of rain, by sprinkling water over the animals, but in a more rapid manner than on the application of the light.

These two experiments we repeated several times, with similar results; and we believe the appearance of these spots to be owing to the irritation produced, in the first instance, by the heat and light; in the second, by the mechanical irritation of the water. The animals never awoke during these experiments, except when the artificial rain was too heavy, or continued for a long time.

Shortly after these animals came into our possession, one of them escaped from the greenhouse in which they resided for a time; and it was not until after a very diligent search, that we discovered it amongst some long grass, of a colour which surprised us much. It appeared at first sight to be speckled black and white; on closer examination, however, the dark colour was between Nos. 96. and 110.,—the light apparently a mixture of Nos. 6. and 13., No. 6. peculiarly. These colours were in large irregular patches. While of this hue, its dimensions were unusually small, its sides were much compressed, and we may state generally, that when of a dark colour, they were usually in a compressed state; for though in the case just mentioned there was an approach to a white at some places, still the dark colour was most profuse.

On one occasion, we remarked the effects of strong passion on these animals. Wishing to take one of them out of the cage in which they were usually confined, and approaching the hand towards it for that purpose, the animal retreated for a little at first, then on a sudden turned round and seized one of our fingers, without further mischief, however, than slightly raising the cuticle. At this moment the colour changed from the usual greenish mixture to that of a yellowish-grey, approaching to No. 13, spotted over, at the same time, with numerous red points (No. 79.), about the size of the head of a pin, while the animal became more bulky than we had ever seen it.

Some days before death, which took place, partly, in consequence of the inclemency of the weather, but particularly, we believe, in consequence of the want of food at the time, the flies having nearly all disappeared, worms and other small animals were rejected, they gradually became weaker and weaker, left the twigs, and came to the floor of the cage. While in this weak state, their colour differed from any we ever observed them to assume while in health. They became of the following hues, viz. yellow, approaching to No. 75, and purple, somewhat like No. 96. These colours were in large irregular patches, and seemed gradually to brighten as the animals became weaker, until on death they were brightest, (No. 63.)

From frequent observation, we found, that during the day, while in health, a slight change in the shade of colour took place every ten or fifteen minutes. This did not happen at night; the same hue remained then for a much longer time, and altered very little.

We never noticed the change of colour in the slightest degree to depend on the colour of the body on which the animals were placed.

With regard to the transparent property of the body of the chameleon, we have only to say, that on one occasion, we are tolerably sure that we observed the shadow of the wires of the cage, during the bright sunshine, through the body of one of them, while in a compressed state.

These remarks, we think, seem to shew that the existing opinions, which attribute the change of colour to the action of the lungs, as the chief cause, is correct; not we believe entirely, however, owing to the change of colour of the blood, according to the respiration, transmitted by the skin; but conjointly, with its effects on the integuments, rendering them more or less tense or flaccid; and thus enabling the surface to reflect different rays of light at different times, according to the state of the integuments. The mechanical action of the lungs, we presume, must have a similar effect on the skin.

It is curious to observe the opinions of naturalists concerning the change of colour in the chameleon, and we have here subjoined those of the authors we have consulted on this point, in a tabular form.

| AUTHORS. | Opinions concerning the Causes of Change of Colour. |
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| ARISTOTLE. | The change of colour takes place when the animal becomes inflated. |
| PLINY. | Takes the colour of bodies which it approaches, except red and white. |
| WORM. 1655. | From affections of the mind of animal. |
| SOLINUS. | Reflection. |
| The Cartesians. | By disposition of parts that compose the skin giving a different modification to rays of light. |
| KIRCHER. | Imagination of animal. |
| GODDARD. | Granules on skin reflecting colour of bodies adjacent. |
| SONNINI. | Their different affections increase or diminish the intensity of the tints of colour. |
| Author in REES' Encycloped. who quotes the preceding five Authors. | Skin yellow ; blood violet ; change in consequence of different quantities of blood driven into skin at different times. |
| Encyc. Brit. | Changes on exposure to sun ; colour seems to depend on state of health, temperature, and other unknown causes. |
| Encyc. Edin. | Lungs render skin more or less transparent, and also change the colour of the blood according as inflated. |
| LINNÆUS, System. Nat. | Perhaps from being seized with a kind of jaundice. |
| GOLDSMITH, Anim. Nat. | Not from colour of objects it approaches. |
| HASSELQUIST. | From being very subject to jaundice. |
| SHAW, Nat. Hist. | From exposure to sun, changes colour. |
| RUSSELL, Nat. Hist. Alepppo. | From objects on which they happen to be placed. |
| FLEMING, Philos. of Zool. | According to states of animal. |
| French Academicians. | From exposure to sun. |
| LACEPEDE, Ovip. Quad. | Fear, anger, and heat. |
| D'OBSONVILLE. | Blood violet ; vessels and skin yellow ; hence upon quantity of blood driven to skin depends colour. |
| DUMERIL, Dict. de Sciences Nat. | According as blood is sent more or less rapidly in contact with the fresh air inspired. |
| CUVIER, Regne Anim. | According to their wants and passions, lungs render body more or less transparent, and force the blood more or less to flow towards the skin : that fluid coloured more or less brightly according to quantity of air taken into lungs. |
| BARROW, Travels in Africa. | From quantity of oxygen in lungs. |

These quotations shew that the opinions of naturalists on this subject are very various, and even contradictory. However, with the exception of a few, including Dr Russell and Pliny, all seem to agree, that the colour of the cameleon does not depend on that of the body on which it happens to be placed.

Dr Russell drew his conclusions from observing, that sometimes, while on a tree, the colour of the animal approached to that of the bark; and again, while on the grass, after some time it became of a green hue. Now, these two colours are the most usual, as far as our observation goes, which the cameleon assumes, however situated. Coincidences such as these however, we admit, are certainly liable to mislead, especially those, setting about an inquiry of this nature, under the influence of a preconceived theory. But indeed, Dr Russell at the same time admits, that the cameleon does not always assume the colour of the ground on which it is placed, and states, that, when put into a box lined with black, it sometimes became lighter in colour, and *vice versa* when put into a white one. Another objection to this theory is, that the cameleon retains its hue for some time after removal from the spot where it had become of any particular colour, which could not be the case did it depend upon the colour of surrounding objects. This fact we have often noticed, and with the exception of the somewhat ridiculous opinions of Linnæus, Hasselquist, and Kircher, most of the authors we have quoted, either distinctly state, or from their observations on this subject entitle us to infer, that the lungs are the principal agents in the production of the change of colour, their action being apparently modified by the temperature of the air —light—passions or affections of the mind—state of health—various wants—and perhaps other unknown causes.

The opinion which we have adopted in a former part of this paper, approaches to that of "the Cartesians," and also to a certain extent agrees with those who believe that the colour depends upon the quantity or tint of the blood sent to the skin at different times.

In endeavouring to reconcile these two opinions, we would state, that it is evident, from the translucency of the skin, that the blood must have its share in the production of colour; but we doubt whether, even by the modification of colour produced by that of the skin along with it, the various hues observed could be accounted for; so it seems probable, that the particular states of the surface of the skin, must also have a share in the production of colour, by affecting the rays of light differently at different times.

By adopting a modification of these two opinions, it appears to us, that the phenomenon is more satisfactorily explained, than in any other way [*].

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[*] In the end of October 1827, the Editor received several live chameleons from Malaga. One of these lived for nearly a year in a hot-house in Mr Neill's garden at Canonmills, and died only in consequence of meeting with an accidental bruise. Mr Neill informs him, that "when severe winter came on, and flies disappeared, it was fed chiefly with *sclaters* (Oniscus Asellus), which were always to be found under some of the flower-pots sunk in the tan-bed. It also ate centipedes (Scolopendra forficata), and the small almost transparent earth-worms found among the tan; so that food was never awanting. During the winter months, the gardener (Alexander Scott) put the prey into the cameleon's mouth. When summer came on, this was not necessary; the animal became lively; and small-meshed lattices being fixed under the moveable sashes when open, it was permitted to range through the whole extent of the hot-house, climbing and descending, and moving from plant to plant, availing itself very generally of its prehensile tail. It then captured stray flies and spiders of its own accord, watching them on all sides with most anxious eyes,—literally *oculis emissitiis*. The tip of its tongue was often heard to strike the glass sharply when the prey happened to be perched on one of the panes, though the animal was more than half a foot distant at the time. It frequently changed colour; but it is difficult, indeed, to trace the cause or causes of the change. On one occasion, certainly, the colour of the neighbouring leaf seemed to have influenced the colour of the animal. In the morning the chameleon was of a dirty cream-colour, which was the most frequent colour during night, and when asleep. Two or three hours afterwards, a friend (Mr John Linning) having accompanied me to see the animal, it was observed to be of a bright glaucous green on one side of its body, and of a dull leek-green on the other side. The bluish side was directly exposed to the light of the sun passing through a newly unfolded banana leaf, of a delicate texture. I made the chameleon come upon my finger, and then held it in the shade of the crib-stone; and both Mr Linning and I remarked that the two shades of green on the respective sides of the body continued evident for several minutes. Copper-coloured spots soon afterwards gradually developed themselves, the effects probably of changes on the surface of the skin, arising from some degree of excitement or anger. The gardener (who is a very intelligent young man, and an accurate observer) mentions, that, when perched close to the glass-roof, exposed to the full glare of light, the cameleon often became of a very dark hue, almost like soot, but with some large bronze-coloured spots. On these occasions it was generally hanging at-

## *Notice of a new Scottish Locality for the Linnæa borealis.*

By John S. Bushnan, Esq. Member of the Royal Medical and Plinian Societies of Edinburgh. Communicated by the Author. *

It were needless to give a description of the Linnæa borealis, as such is to be found in almost every botanical work; suffice it to say, it is of the class Didynamia, order Angiospermia, and the natural order Aggregatæ of Linnæus, the Caprifoliaceæ of Jussieu.

The flowers of the Linnæa are said, in the Flora Suecica, to be very fragrant at night, smelling like the meadow-sweet. Its leaves have a bitter sub-astringent taste, and are used, in some places, in the form of fomentation for rheumatic pains. An infusion of them is esteemed among the Swedes as a specific in sciatica; and the inhabitants of West Bothnia cure painful complaints in the feet of their sheep, with a cataplasm of this plant. The smoke of it, when burnt, is thought by the Norwegians to be beneficial in scarlet fever, and they use a decoction of it in psora.

There is only one known species of the Linnæa. Sir Joseph Banks had a drawing by an artist who was employed to delineate plants in India, which represents a plant answering to the same generic characters; but of which no specimens have ever been seen. The drawing is supposed to be a forgery: the younger Linnæus, when in England, was much interested by the sight of it, but endeavoured in vain to ascertain its truth.

The known localities of the Linnæa borealis in Britain, are confined, almost solely, to the northern half of what is called the middle division of Scotland, in which there is many a likely shade, still unexplored by the botanist, where the Linnæa may have been yearly "born to blush unseen" by his curious eye,

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tached, with its back downmost, to the wire-trellis, or to one of the cords by which the sashes were moved, so that it was probably in an uneasy position. When removed from its lofty situation, at the time of giving or taking off air, the gardener observed that it acquired its usual green colour in two or three minutes."—Edit.

* Read before the Plinian Society, January 13. 1829.

and undisturbed by his rapacious hand. During the examination of any plant, the mind often reverts to the father of the science, with pleasing emotions of gratitude for the facilities and certainties which guide it in its search after knowledge and recreative amusement; but that plant which Linnæus, from the thousands he had seen, selected to transmit his name to posterity, can never fail to draw from the mind of the botanist, a double share of such filial offerings. This little plant appears, from the Lachesis Lapponica of Linnæus, to have been chosen by himself to commemorate his name, when he gathered it at Lyksele on the 29th of May 1732. It was formerly known as the Campanula serpyllifolia of John and Gaspard Bauhin, Tournefort, Morrison, Ray, &c.; but Linnæus soon ascertained it to be a distinct genus, and, with his consent, his name was given to it by his friend Dr Gronovius, and as such was published in the Genera Plantarum in 1737. From the Critica Botanica, we learn that Linnæus himself found a resemblance of his own early fate in the history of "this little northern plant, long overlooked, depressed, abject, flowering early," and, adds Sir J. E. Smith, "more honoured in the name than any other: few could have been better chosen, and the progress of practical botany in Britain seems to be marked by the more frequent discovery of the Linnæa."

The Linnæa borealis thus pre-eminently distinguished, and so interesting to the botanist, has yet a further, though a far slighter, claim on the regards of every Scottish votary of Flora, as being first made known as a denizen of Britain, by a Beattie, a name dear to every lover of poetry and truth. In 1795, Professor James Beattie found it in an old fir wood at Inglis Maddie, on the borders of Mearnshire. He sent specimens of it to the Linnean Society, and his discovery was published in the third volume of their transactions. Since that time, other localities in Aberdeenshire have been made known to the botanical world. Mr Craigie, according to Dr Hooker, found it in several woods, and Maughan at Crebstone and Kemnay in the same county. Messrs Brown have recorded it as growing in a wood at the back of the hill of Kinnoul near Perth, which, as far as I am aware, is the most southerly station, that can, as yet, be assigned to the

Linnæa in Britain.* I have seen specimens of the Linnæa from the woods near Gordon Castle, where it was discovered by Mr James Hoy, the long cherished friend and companion of his patron the late Duke of Gordon. So alive was Mr Hoy to the pleasure of botany, and so desirous for the progress of the science, that he many a day kept in profound, and what to some may appear selfish, but what I should call laudable secrecy, the spot where grew the emblem of him from whose labours he had derived so much real enjoyment. Prudently declining the requests of the merely curious and inquisitive, and justly giving a decided refusal to the solicitations of the unsatiable and unsparing purveyors for the herbarium, he, at all times, was ready to listen to the true lovers of science who occasionally applied to him, and, with delight, guided their footsteps through the rarely trodden path leading to his treasure in the woods. Conscious, however, that, in the course of nature, he could not long remain to be such a guide to the visitants, "few and far between," and, fearing that his discovery should die with him, at the advanced age of eighty years, he, a few months before his death, made known *his* locality of the Linnæa borealis to several individuals residing in the neighbourhood.

A few years ago, it was found by Mr George Anderson, Secretary of the Northern Institution, at Drummond, near Inverness, where one patch only was found, which, as no flowers were perceived, was considered completely barren, and, as such, is mentioned by Dr Hooker in the Flora Scotica; and Mr Sanders, the intelligent and obliging gardener at Gordon Castle, informs me, that he has never found flowers on the plants in the woods near the castle, although some specimens transplanted into the garden have repeatedly flowered. From the well known assiduity and accuracy of these observers, it would ill become me to express a different opinion with regard to these patches of the Linnæa; but I am loath to leave the north under such a stigma of barrenness, and beg leave to remind the Society of the peculiar evanescence of its flowers, and the consequently redoubled attention necessary to be given to it. It should, however, be observed, that the period at which the Linnæa comes into flower, varies in different seasons, from about the beginning of May to the end of June; and as the plant is usually confined to an isolated locality, seldom exceeding one or two square yards, it is most probable that all the flowers will be nearly, at the same time, in a state of maturation: the inflorescence, too, is very ephemeral, seldom exceeding a week's duration; and as no fruit has, as yet, been found in Britain, all traces of the flowering are obliterated with the fall of the corolla. It is, therefore, very possible that a person not closely attending to the Linnæa, from these circumstances might be led into the opinion, that the plant never had been in a state of inflorescence. He might visit the station at two periods, separated by a very short interval; at the one, the plants might appear bearing their numerous and beautiful corollæ, calling forth the homage of every admirer of Flora, while, at the other, they could shew him no traces of their former glory.

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* It has been found, sparingly, in Northumberland by Mr Trevelyan.—Edit.

The Linnæa is usually discovered in shady and old fir woods, and is, by Linnæus, stated to occur interwoven with ivy. The station on the Knock of Alves is, by no means, so sheltered as might be supposed; there are few trees in the very immediate vicinity, and they have been but lately introduced. The plants grow in a very vigorous condition, though on a thin and excessively barren soil, partly covering the bare sandstone rock with its slender and trailing stems interwoven into a very dense mat, completely clothing the ground and extirpating every other plant from the station. The size of the patch is about two square yards.

The station I have now made known, may be considered as the most northerly locality for the Linnæa as yet discovered in Britain, as I am informed that the plants found near Inverness have all been carried away or destroyed. It was discovered in full flower on the Knock of Alves in June last by Mr Wilson, the learned and scientific schoolmaster of the parish, who was struck with its peculiar beauty and elegance. It was entirely new to him, and, carrying home a single stem for examination, he was agreeably surprized to find, by referring to Smith's Compendium, that it was the far-famed Linnæa; thus verifying the opinion of its late lamented author, that the discovery of the

Linnæa, in some measure would keep pace with the progress of practical botany in Britain.

The Knock of Alves is immediately on the south side of a road leading from Elgin to Forres, lying about three miles from the former place, and forming part of the estate of A. Forteath, Esq. of Newton. The plant grows on the north side of the hill, within a few yards of a tower erected on the top, to the memory of the late Duke of York. The access to the tower is by a path gently winding up to the top of the hill, and, in forming this path, part of the Linnæa has evidently been cut away, and botanists have to congratulate themselves that this beautiful and interesting plant has not entirely been swept off: so narrow indeed is the escape the Linnæa has made, that the honest countrymen of Moray, did they know its rarity and value in the eye of the botanist, would not hesitate to ascribe its preservation from the ruthless agency of the spade and pick-axe to the weird sisterhood, wishful to preserve this ornament to their Knock, which, since the days of Macbeth, has been held to be their favourite place of nightly gathering and resort.

*Mr Macgillivray, Assistant-keeper of the Royal Museum, Edinburgh, communicates the following note in regard to the Linnæa:—*

Two large patches of Linnæa borealis occur in a fir wood on the south side of the river Don, opposite Fintray House, about seven miles from Aberdeen. The first patch was discovered by Mr Craigie, the second by myself while searching for Mr Craigie's patch.

Several localities in Aberdeenshire were also discovered by the Rev. Mr Mackie, now a preacher in Holland.

# *An Attempt at a New Classification of the Cichoraceæ, with some Observations on the Geographical Distribution of this Family.* By Mr David Don, Librarian of the Linnean Society, Member of the Imperial Academy Naturæ Curiosorum, of the Royal Botanical Society of Ratisbon, and of the Wernerian Society of Edinburgh, &c. Communicated by the Author.

Whatever opinion there may be respecting the other families into which this extensive class of plants has been divided, all writers, from the earliest period down to the present time, have agreed in separating the *Cichoraceæ* from the rest of *Compositæ*. They are essentially distinguished from the other families by their uniform, ligulate, hermaphrodite florets, having a definite number of simple parallel vessels traversing their lamina.

It is curious to remark the distribution of this family over the surface of the globe, and the proportion which it bears to the rest of *Compositæ* in the Floras of different countries. These will be best exhibited by the following table.

| | |
|---|---|
| Flora of Great Britain, | 1 to 2 |
| Sweden, | 1 ... 2½ |
| Lapland, | 1 ... 2 |
| Switzerland, | 1 ... 1⅙ |
| Greece, | 1 ... 2 |
| Crimea, | 1 ... 2¼ |
| North Africa, | 1 ... 3 |
| Siberia, | 1 ... 4 |
| Nepal, | 1 ... 6 |
| Japan, | 1 ... 3 |
| North America, | 1 ... 9 |
| South America, | 1 ...45 |

By this table it will be seen that the principal seat of *Cichoraceæ* is in Europe, and that they decrease very considerably in America—or rather, that the other families of *Compositæ* experience a very great increase in the latter continent; for the total number of *Cichoraceæ*, in the North American Flora, equals that of the North of Africa, while in the rest of *Compositæ* it has nearly four times the number. In the Flora of Switzerland, out of 287 *Compositæ*, 114 belong to *Cichoraceæ;* and in the Grecian Flora, the total number of *Compositæ* is 310, of which 102 are of this family. Their number appears to decrease considerably eastward; for in the Flora of the Crimea, of 301 *Compositæ*, 86 belong to *Cichoraceæ;* and in the Siberian Flora, there are only 33 out of 176. As subdivision is absolutely necessary in all extensive families, in order to facilitate a knowledge of the individuals of which they are composed, I have therefore attempted to separate the *Cichoraceæ* into certain groups, the characters of which are given in the following arrangement. A list of the genera belonging to each is also added, and such as are new I have denoted by an asterisk.

In order to render this memoir as complete as possible, I have added the characters of the new groups, which are here proposed for the first time; and also of such of the other genera as have been hitherto imperfectly defined. The latter have been entirely remodelled, and many of them may also be regarded as new combinations of species. There still remain, however, a few genera which I have not had an opportunity of examining in sufficient detail, to enable me to assign to them their particular stations in this family. The anthers of *Cichoraceæ*, like the rest of *Compositæ*, are unilocular, and composed of two valves, —an important character, which does not appear to have been before noticed.

### FAM. CICHORACEÆ, *Juss.*

*Flosculi* ligulati, hermaphroditi, uniformes: *ligulâ* apice 5-dentatâ, 6-nerviâ: *nervis* rectis, parallelis, parùm infra dentium sinus furcatis. *Antheræ* valvulis angustissimis, cristâ membranaceâ pellucidâ coronatæ, basi bisetæ (setis dentibusve membranaceis) s. ligulâ simplici truncatâ auctæ. *Stigmata* libera, filiformia v. semicylindrica, obtusa, papillosa. *Achenia* nunc apice calva.

Plantæ lactescentes. Folia alterna. Flores sæpiùs lutei.

Trib. 1. HIERACEÆ. *Receptaculum* epaleatum. *Antheræ* basi interiore ligulâ simplici membranaceâ truncatâ auctæ. *Involucrum* polyphyllum.

*Genera.* Hieracium. Hapalostephium.* Crepis. Prenanthes. Harpalyce.* Chorisma.* Andryala, *L. Schreb.* Rothia, *Schreb. Willd.* Lapsana, *L. Schreb.*

Trib. 2. TARAXACEÆ. *Receptaculum* epaleatum. *Antheræ* basi bisetæ. *Pappus* plerumque persistens. *Involucrum* polyphyllum.

*Genera.* Leontodon, *Schreb.* Apargia, *Scop.* Oporinia.* Thrincia, *Roth.* Calliopea.* Æthonia.* Tolpis, *Adans. Gærtn.* Hedypnois, *Schreb.* Rhagadiolus, *Gærtn.* Hyoseris, *Schreb.* Zacintha, *Gærtn.* Troximon. Cynthia.* Picris, *L.* Helmintia, *Juss.*

Trib. 3. HYPOCHŒRIDEÆ. *Receptaculum* paleis distinctis refertum. *Antheræ* basi bidentatæ. *Pappus* persistens. *Involucrum* polyphyllum.

*Genera.* Hypochœris, *Gærtn.* Achyrophorus, *Scop.* Seriola, *L.* Agenora.* Soldevilla, *Lag.*

Trib. 4. LACTUCEÆ. *Receptaculum* epaleatum. *Antheræ* basi bidentatæ. *Pappus* fugax, mollissimus, capillaceus.

*Genera.* Lactuca, *L.* Chondrilla, *L.* Agathyrsus.* Lygodesmia.* Atalanthus.* Sonchus. Barkhausia, *Mœnch.*

Trib. 5. SCORZONEREÆ. *Receptaculum* epaleatum. *Antheræ* basi bisetæ, appendiculâ exiguâ reniformi! coronatæ. *Stigmata* sæpiùs filiformia, papillosa. *Involucrum* simplex v. imbricatum.

*Genera.* Scorzonera, *L.* Picridium, *Desf.* Arnopogon, *Willd.* Tragopogon, *L.* Geropogon, *L.*

Trib. 6. CICHOREÆ. *Receptaculum* paleatum. *Antheræ* basi bidentatæ, appendiculâ exiguâ marcescente coronatæ. *Stigmata* semicylindrica, papillosa. *Pappus* persistens, paleaceus. *Involucrum* polyphyllum, squarrosum.

*Genera.* Cichorium, *L.* Scolymus, *L.*

Trib. 7. CATANANCHEÆ. *Receptaculum* paleatum. *Filamenta* articulo superiore longo, tereti. *Antheræ* basi biauriculatæ, appendiculâ orbiculatâ coronatæ. *Stigmata* crassa, brevia, ligulata! obtusa, pruinosa. *Pappus* paleaceus. *Involucrum* scariosum.

*Genus.* Catananche, *L.*

### TRIB. 1.

1. HIERACIUM. *Involucrum* imbricatum. *Receptaculum* subfavosum. *Achenia* apice simplicia. *Pappi radiis* simplici ordine copiosis, persistentibus, setaceo-pilosis.

Herbæ *polymorphæ, radice perenni.* Flores *lutei, solitarii v. corymbosi.* Hùc Hieracia ferè omnia auctorum.

2. HAPALOSTEPHIUM. *Involucrum* triplici ordine polyphyllum laxè imbricatum. *Receptaculum* scrobiculatum. *Achenia* ancipiti-compressa, lævia, apice attenuata: *disco epigyno* planiusculo, dilatato! *Pappi radiis* duplici ordine copiosissimis, capillaceis, mollissimis, caducis.

Herbæ (Europ. Amer. et Asiæ Bor.) *perennes, pilosæ.* Folia *amplexicaulia, sinuato-dentata.* Flores *aurei, corymbosi.* Involucrum *sæpius hispidè pilosissimum.* Pappus *niveus!*
Hùc Hieracium pyrenaicum *L.* (Lepicaune multicaulis *Lapeyr.*)

H. paludosum *L.* Crepis Sibirica *L.* Hieracium macrophyllum *Pursh.*

3. CREPIS. *Involucrum* simplici ordine polyphyllum, connivens, demùm torulosum, basi squamis plurimis accessoriis calyculatum. *Receptaculum* levitèr favosum. *Flosculi* fauce nudâ. *Achenia* fusiformia, sulcis plurimis notata, apice attenuata, simplicia. *Pappus* tenuissimè capillaceus, mollissimus, fugax: *radiis* triplici serie confertissimis.

Herbæ (Europææ) *radice annua, caulescentes.* Folia *sæpius runcinata.* Flores *aurei.*

Hùc pertinent Crepis biennis *L.* C. Dioscoridis *L.* C. tectorum *L.* C. fœtida *L.*

4. PRENANTHES. *Involucrum* pentaphyllum, tubulatum, basi squamis plurimis brevissimis imbricatis munitum. *Receptaculum* glabrum. *Flosculi 5.* *Stigmata* filiformia, hispidula. *Achenia* angusta, hinc convexa, lævia, indè carinata: *disco epigyno* concavo, parùm dilatato. *Pappus* capillaceus, mollissimus, fugax: *radiis* duplici ordine confertis.

Herba (Europæa) *perennis, radice repenti.* Folia *integra, amplexicaulia, glaucescentia.* Flores *parvi, purpurei, diffuse paniculati.* Pappus *niveus.*

Hùc Prenanthes purpurea *L.*

5. HARPALYCE. *Involucrum* simplici ordine polyphyllum, cylindricum, basi squamis aliquot brevissimis adpressis instructum. *Receptaculum* levitèr favosum. *Flosculi* indefiniti. *Stigmata* filiformia, hispidula. *Achenia* angusta, angulata, sulcata, apice simplicia. *Pappus* pilosus, rigens, fragilis, persistens, coloratus: *radiis* duplici ordine confertis, denticulato-scabris.

Herbæ (Amer. Bor.) *perennes, robustæ.* Folia *sæpius petiolata, lobata.* Flores *paniculati, albi v. rosei.* Pappus *fulvus.*

Ad hocce genus pertinent Prenanthes alba *L.* P. altissima *L.* P. cordata *Pursh.* P. serpentaria *Pursh.* P. virgata *Mich.* P. simplex *Pursh.* P. crepidina *Mich.* P. racemosa *Mich.*

Ligulæ in *H. virgata* 10-nerviæ, nervis secundariis manifestis!

6. CHORISMA. *Involucrum* 8-phyllum, basi squamis ovatis aliquot munitum: *foliolis* lanceolatis, margine scariosis, invicem se imbricatis. *Receptaculum* nudum. *Flosculi* plures (12). *Stigmata* filiformia, minutè papillosa. *Achenia* subfusiformia, compressa, sulcata, glabra, apice attenuata: *disco epigyno* dilatato, planiusculo. *Pappus* capillaris, mollissimus, fugax: *radiis* triplici ordine confertis, minutissimè denticulatis.

Herba (Ins. Curil. habitans) *perennis, sarmentosa, humifusa, habitu peculiari.* Caules *filiformes, longissimi, repentes, ad articulos radices emittentes.* Folia *solitaria, remota, petiolata, ternata v. profunde tripartita;* segmentis lateralibus *bilobis;* intermedio *trilobato.* Petioli *sesqui v. tripollicares, canaliculati, dimidio inferiore subterraneo.* Flores *pro ratione plantæ magni, pallide cærulei, subsolitarii, remoti, pedunculati.* Pedunculi *triunciales, uni- v. triflori.* Involucrum *lævissimum, longitudine unguiculare.*

Hùc Prenanthes repens *L.*

TRIB. 2.

7. **OPORINIA.** *Involucrum* profundè multipartitum, basi squamis aliquot adpressis munitum. *Receptaculum* favosum. *Antheræ* basi bisetæ. *Achenia* subfusiformia, compressa, sulcata: *sulcis* transversè rugosis. *Pappi radiis* simplici ordine distinctis, persistentibus, plumosis, basi scarioso-dilatatis!

Herba (Europæa) *perennis, radice præmorsa.* Folia *plurima radicalia, læviuscula, sæpius pinnatifida.* Scapi *ramosi, declinati, glabri.* Flores *pedunculati, aurei.* Pedunculi *squamosi, fistulosi, apice dilatati.*

Hùc Apargia autumnalis *Willd.* Apargia longè diversa est involucro imbricato, pappi radiis duplici ordine digestis; exterioribus simplicibus duplò brevioribus.

8. **CALLIOPEA.** *Involucrum* simplici serie polyphyllum, subtorulosum, basi squamulis paucis instructum. *Receptaculum* nudum, punctatum. *Flosculi* fauce extùs imberbi! *Antheræ* basi bisetæ. *Stigmata* pruinosa. *Achenia* teretia, lævia. *Pappus* capillaris: *radiis* simplici ordine confertis, denticulatis, æqualibus, caducis.

Herba (Europæa) *perennis, cæspitosa, radice fibrosa.* Folia *radicalia, petiolata, runcinata, glabra.* Scapus *uniflorus, lævis.* Flos *saturate fulvus.* Involucri squamis *carinatis, satis aterrimis hispidis, apice membranaceis.* Pappus *niveus.*

Hùc Leontodon aureum *L.*

9. **ÆTHONIA.** *Involucrum* simplici ordine polyphyllum, basi squamis brevissimis adpressis munitum. *Receptaculum* scrobiculato-scabrum. *Antheræ* basi bisetæ. *Stigmata* lineari-ligulata, papillosa. *Achenia* pentagona: *angulis* sulcatis, lævibus. *Pappi radii* 12, setaceis, denticulato-scabris, æqualibus, persistentibus, imâ basi callosis!

Plantæ (Canarienses) *suffruticosæ.* Folia *dentata.* Flores *citrini.*

Hùc Hieracium fruticosum *Willd.* Crepis filiformis *Hort. Kew.*; et Tolpis lagopoda *Sm. Can.* Tolpis genere certè distinctissima involucro squamis plurimis prælongis laxis calyculatum, receptaculo alveolato, acheniis ancipiti-compressis, pappo paleaceo difformi.

10. **TROXIMON.** *Involucrum* duplici ordine polyphyllum: *foliolis* æqualibus, adpressis. *Receptaculum* favosum. *Antheræ* basi biaristatæ. *Stigmata* semicylindrica, papillosa. *Achenia* elongata, sulcata. *Pappi radiis* duplici ordine digestis, persistentibus, setaceo-paleaceis, longis, æqualibus.

Herbæ (Amer. Bor.) *perennes,* foliis *gramineis,* scapis *unifloris,* floribus *luteis.*

Hùc Troximon dandelion *Gærtn.* T. glaucus *Pursh.* T. cuspidatus *Pursh.*

11. **CYNTHIA.** *Involucrum* multipartitum: *segmentis* duplici ordine digestis. *Receptaculum* scrobiculatum. *Antheræ* basi bidentatæ. *Stigmata* lineari-ligulata, pruinosa. *Achenia* ovalia, complanata. *Pappus* duplex; *exterior* paleaceus, brevissimus; *interior* pilosus, scaber.

Herba (Amer. Bor.) *perennis, glaberrima, glauca.* Caules *nudiusculi, 2-3-flori.* Folia *lævissima, oblonga;* radicalia *lyrata;* caulina superiora *integerrima.* Flores *aurei.* Involucrum *læve.*

Hùc Troximon virginicus *Gærtn.*

## TRIB. 3.

12. **HYPOCHŒRIS.** *Involucrum* imbricatum. *Pappus* plumosus; disci stipitatus; peripheriæ sessilis.

Herbæ (Europææ) *annuæ, ramosæ, glabræ.* Folia *sinuato-dentata.* Flores *parvi, aurei.*
Hùc Hypochœris glabra *L.* H. minima *Desf.*

13. **ACHYROPHORUS.** *Involucrum* imbricatum. *Pappus* uniformis, stipitatus, plumosus: *radiis* basi simplicibus.

Herbæ (Europææ) *perennes.* Folia *pilosa.* Scapus *simplex v. divisus.* Flores *aurei.*
Hùc referendæ Hypochœris radicata et maculata *L.*

14. **SERIOLA.** *Involucrum* simplici serie polyphyllum. *Pappus* uniformis, stipitatus, plumosus: *radiis* basi dilatato-paleaceis.

Herbæ (Europæ Australis) *annuæ, ramosæ.* Folia *dentata.* Flores *aurei.* Involucrum *hispide pilosum.*
Hùc referendæ Seriola Æthnensis *L.* S. Cretensis *L.* S. urens *L.*

15. **AGENORA.** *Involucrum* duplici ordine polyphyllum, subimbricatum. *Pappus* pilosus; disci stipitatus: *radiis* subsetaceis, denticulato-scabris.

Herba (Mauritanica) *perennis, glabra.* Scapus *divisus.* Folia *plurima radicalia, sinuato-dentata.* Flores *aurei.* Involucrum *læve.*
Hùc Seriola lævigata *L.*

OBS. Rodigia commutata, *Spreng.* genere omninò diversa videtur.

16. **SOLDEVILLA.** *Involucrum* imbricatum, basi ventricosum. *Achenia* apice calva!

Herba (Hispanica) *annua, pilis ramosis hispida.* Folia *integra.* Pedunculi *apicem versus dilatati.* Flores *aurei.* Involucrum *pilis ramosis, setaceis vestitum.*
Hùc Soldevilla setosa, *Lag.*

## TRIB. 4.

17. **AGATHYRSUS.** *Involucrum* polyphyllum, adpressè imbricatum, teres, basi imbricatum: *squamis intimis* elongatis, conniventibus. *Receptaculum* glaberrimum. *Flosculi* indefiniti. *Antheræ* basi obtusè bidentatæ. *Achenia* ancipiti-compressa, facie utraque 5-costata, transversim rugulosa, apice pauló attenuata: *disco epigyno* planiusculo, dilatato! *Pappus* tenuissimè capillaceus, fugax: *radiis* triplici ordine digestis, copiosissimis.

Herbæ (Europæ, Asiæ, et Amer. frigidior.) *perennes, caulescentes.* Flores *corymboso-paniculati, cærulei.* Pappus *niveus.*
Ad hocce genus pertinent Sonchus alpinus *L.* S. Plumieri *L.* S. floridanus *L.* S. cœruleus *Sm.* S. cyaneus *Fl. Nepal.* S. spicatus *Lam.* S. prenanthoides *M. B.* S. cacaliæfolius *M. B.* S. sibiricus *L.* S. tataricus *L.* S. pulchellus *Pursh.*
Ad Lactucam referendæ Prenanthes muralis et viminea *L.*; hæc involucro structurâ simili et receptaculo glabro Agathyrso proxima, sed pappo longè stipitato abundè diversa videtur. Chondrilla facilè a Lactucâ distinguenda, involucro simplici ordine polyphyllo, basi squamis pluribus calyculato.

18. **LYGODESMIA.** *Involucrum* pentaphyllum, tubulatum, basi squamis plurimis brevissimis imbricatis munitum: *foliolis* ligulatis, carinatis, margine scariosis. *Receptaculum* scrobiculatum. *Flosculi* 5. *Antheræ* basi bidentatæ. *Achenia* linearia, compressa, sulcata, apice simplicia. *Pappus* capillaris: *radiis* multiplici ordine copiosissimis, denticulato-scabris, subpersistentibus.

Suffrutices (Amer. Bor. et Syriæ) *facie* Ephedræ, *ramosissimi, aphylli: ramis teretibus sulcatis v. triquetris, squamis* (foliorum rudimentis) *subulatis, patulis, sparsis.* Flores *solitarii, sessiles.* Pappus *comosus, fuscescens.*

Hùc Prenanthes juncea *Pursh.* P. pumila *Baldw.* P. triquetra *Labill.* Genus facie et charactere omninò diversissimum.

19. **ATALANTHUS.** *Involucrum* cylindricum, polyphyllum, imbricatum: *squamis* membranaceis, adpressis. *Receptaculum* favosum. *Flosculi* indefiniti. *Antheræ* basi bisetæ. *Stigmata* filiformia, spiralitèr tortuosa. *Achenia* linearia, ancipiti-compressa, sulcata, apice simplicia. *Pappus* tenuissimè capillaceus, mollissimus, fugax: *radiis* basi fasciculatim connexis; *aliis* intermediis longioribus, duplò crassioribusque.

Frutices (Insul. Can. et Mediterran. rupibus littoreis proprii) *ramosissimi.* Folia *pinnatifida.* Flores *aurei, solitarii v. corymbosi.* Pappus *niveus.*

Hùc Prenanthes pinnata *L.* P. spinosa *Vahl.*

20. **SONCHUS.** *Involucrum* polyphyllum, adpressè imbricatum, basi dilatatum, apice connivens. *Receptaculum* scrobiculatum, scrobiculorum marginibus elevatis laceratis scabrum, levitèr favosum. *Flosculi* indefiniti; *fauce* extùs villosissimâ. *Antheræ* basi acutè bidentatæ. *Stigmata* hispidula. *Achenia* ancipiti-compressa, sulcata, jugis transversim rugosis scabra, apice simplicia. *Pappus* tenuissimè capillaceus, mollissimus, fugax: *radiis* copiosissimis, inæqualibus, basi fasciculatim connatis!

Herbæ (Europææ) *robustæ, radice perenni.* Folia *sæpius runcinata.* Flores *aurei, corymbosi, raro subsolitarii.*

Hùc Sonchus arvensis *L.* S. palustris *L.*, et planta Pallasiana floribus subsolitariis, involucris lævibus. S. oleraceus parùm differt radice annuâ, et receptaculo glabro.

21. **BARKHAUSIA.** *Involucrum* simplici ordine poly (7–8)-phyllum, connivens, torulosum, basi squamis pluribus (8–9) dilatatis, scariosis calyculatum. *Receptaculum* favosum: *laciniis* ciliatis. *Flosculi* indefiniti. *Antheræ* basi bisetæ. *Stigmata* filiformia, spiralitèr revoluta, minutè papillosa. *Achenia* fusiformia, sulcata, levitèr muricata, apice attenuato, elongato, scabro. *Pappi radiis* triplici ordine digestis, tenuissimè capillaceis, denticulatis.

Herbæ (Europææ) *erectæ, ramosæ, radice annua.* Flores *solitarii, longe pedunculati.*

Hùc referendæ Crepis alpina *L.* C. rubra *L.* An etiam C. vesicaria *L.* et Barkhausia purpurea et hyemalis *Bivon ?*

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*Note.*—In the preceding Number of this Journal, at page 22 line 22, for *albumen* read *alburnum*; and at page 53, line 1, for *six* read *four.*

# *The unsatisfactory Nature of the Theories proposed to account for the Descent of the Radicles in the Germination of Seeds, shewn by Experiments.* By HENRY JOHNSON, Esq. Member of the Royal Medical Society of Edinburgh.

THE singular tendencies of the plume and radicle, the one invariably upwards into the air, the other downwards into the earth, which are among the most curious phenomena of vegetation, have been variously accounted for by several distinguished phytologists. Theories have been framed by MM. Parent [*], Du Hamel [†], and De la Hire [‡], by Dr Darwin [||], and by Mr Knight [§]. None of these, however, excepting the two last mentioned, appear to have attracted much attention, or met with any advocates among modern botanists.

The interesting nature of this subject, and the desire of learning the cause of these opposite and singular tendencies, have induced me to pay considerable attention to the phenomena, and to perform many experiments, several of which, I believe, are original; and the results of which appear not easily reconcilable with the theories above mentioned. In the present communication, therefore, I shall as shortly as possible adduce a few of these [¶], and the conclusions to which they seem to lead, confining my remarks at present principally to the cause of the descent of the radicle.

I. According to the theory of Dr Darwin, "the plumula is stimulated by air into action, and elongates itself where it is most excited; and the radicle is stimulated by moisture, and elongates itself where it is most excited."—*Phytolog.* p. 144.

EXPER. I.—A small slip of tinned iron, about three-fourths of an inch in diameter, was bent into a circular form, and to the

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[*] Physique des Arbres.

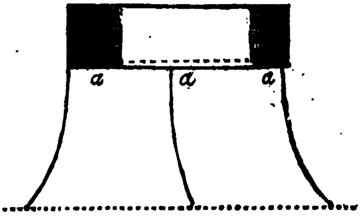
[†] Physique des Arbres.

[‡] Phytologia, p. 144.

[||] Davy's Agricult. Chem.

[§] Philos. Trans. Lond. 1806.

[¶] The experiments contained in this communication were related in a paper read before the Royal Med. Soc. of Edinb. in January 1828.



sides of this hoop so formed, three slender iron-wire legs were fixed, as here represented. To the lower surface, *a*, *a*, *a*, some thread-net was stitched, and the space above this being then filled with moistened soil, nine mustard-seeds, which had already protruded their radicles, being procured, the latter were pushed gently upwards (*i. e.* through the net) into the moistened soil, at its lower surface, *a*, *a*, *a*. Eight of these lived, and *grew downwards*, so as to become hooked in the meshes of the net. See note on Experiment 4.

Exper. II.—A common horse-bean, having a very straight radicle, and already about an inch long, was fixed securely at the bottom of a glass, in such a manner that the radicle pointed directly upwards. It was then completely covered with water. In a few days the radicle became considerably curved *downwards*, and the plume, having now grown out, had directed itself *upwards*.

1*st*, It is remarked by Mr Keith *, and I think very justly, that, according to this theory of Dr Darwin, the radicle, if lodged in an insulated mass of mould, and in an inverted position, ought certainly to elongate itself in that direction, perpendicularly upwards, instead of downwards.

In the first experiment above described, I believe these conditions were exactly fulfilled—yet the result was far different: for, instead of continuing to grow in the direction in which they were placed, they *immediately turned downwards*. But, if the radicle grew downwards in ordinary circumstances, because it is "most excited" in that direction, by the moist earth beneath,—in this experiment it ought surely to have grown upwards, for here the moist soil was placed above.

2*dly*, In Experiment II, if the contact of air with the plume was not entirely prevented (as the water would contain some), it must, at least, have been equally stimulated by air on every side, and ought therefore to grow as readily in one direction as in another: and the radicle, surrounded as it was on every side, and therefore equally "excited" in every direction, might be expected to continue its growth in any position in which it was placed. But, instead of this, the plume, as it was gradually protruded from the cotyledons, turned itself upwards, as usual —and the radicle downwards.

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* Syst. of Physiolog. Botany, vol. ii. p. 25.

It might also be objected to this theory, that it does not at all explain why these directions should be so exactly perpendicularly upwards and downwards; and there are others which, I think, might be reasonably adduced. But I do not wish to extend the present essay, by offering arguments, which are far less satisfactory than the results of the foregoing experiments.

II. The following experiments and remarks apply to the theory of Mr Knight, which attributes the effects in question to the agency of gravitation [*]; a theory which is most ably supported by his most ingenious reasonings and experiments.

Exper. III.—A small iron-wire ring, on which was stretched some net, was fixed in the mouth of an ale-glass. It was placed about an inch below the brim, and the space above it being filled with mould, several mustard seeds were sown in it. This experiment, several times repeated, has given the following results. The radicles having penetrated downwards through the net, have grown more or less directly downwards into the space below this; but they have never attempted by turning *upwards to re-enter* the soil, even though they have, in some cases, attained the length of half an inch.

Exper. IV.—The little apparatus mentioned in Experiment I., being filled with soil, and some mustard seeds being sown in it, and watered daily, afforded, in repeated trials, the following very curious result. As soon as germination had commenced, the radicles grew downwards, and appeared at the lower surface of the net. But, no sooner had they penetrated through this, than, instead of continuing their ordinary direction, as in the former experiments, having just attained a length of about one-eighth of an inch, they invariably began to turn *upwards*, endeavouring to *regain the soil*, often creeping along its under surface, or even perforating the net two or three times; and only those newly protruded growing straight downwards [†].

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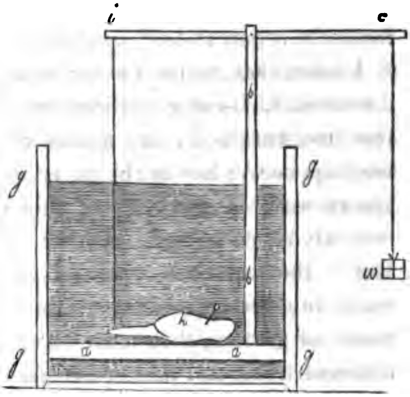
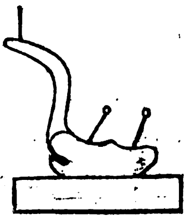
[*] Phil. Trans. 1806.

[†] The same ultimately took place with the radicles mentioned in experiment I., after they had got out of the soil; in every one there was some apparent effort to turn towards the net.

Exper. V.—A sponge was fixed into the mouth of an ale-glass, and its surface cut smooth on a level with the brim. Some mustard seeds previously well soaked, were pushed a little way into the surface of the sponge, in order to retain their whole surfaces moist. This apparatus was then tied up in the garden, with the mouth of the glass downwards, and moistened daily. In four days twelve had germinated, and three had grown *regularly upwards* into the sponge. None grew *downwards*, but all had endeavoured, more or less, to avail themselves of the moisture of the sponge, by running along its under surface. Soon after this, they became unhealthy.



Exper. VI.—Into a thin slip of wood, *a a* was fixed an upright, *b b*, having a notch at its upper end, in which was fixed the slender wooden beam *i c*, turning on a fine needle. The apparatus so constructed, was then fixed in the bottom of a jar, *g g g g*. A bean *h*, the radicle of which projected horizontally from the cotyledons, was fixed by a pin to the lower piece of wood, *a a*. A thread passed through the apex of the radicle, connected it with the beam, the other extremity of which was counterpoised by a ten grain weight, *w*. Lastly, water was poured into the jar, sufficient to cover the bean. By means of a very simple contrivance, I could detect the slightest depression of the beam; and in two days this was obvious at the extremity *i*, to the amount of about one-tenth of an inch.



The same experiment was repeated on a bean, whose radicle was directed upwards, and the light being partially excluded. In two days this likewise most obviously curved downwards, at the same time, for an obvious reason, the beam became raised. The annexed sketch represents its appearance, at the close of the experiment.

On these experiments I now make a few observations.

1. The remarkable difference in the results of experiments III. and IV. (a difference of which words alone convey, I fear, but an imperfect idea), can I conceive only be attributed to this circumstance, in which alone they were not analogous, viz. the presence in the one case, and the absence in the other, of moisture below the net. In experiment III. the radicles, when protruded, had to grow into the lower part of the glass, where they were surrounded with moist air. Whilst in experiment IV., from the construction of the apparatus, a current of dry air would be freely admitted to them. In the one case the radicles continued to follow their ordinary direction *downwards*, in the other they instantly began to tend *upwards*.

I infer, that, in the former case, the radicles grew as usual downwards, because sufficiently supplied with moisture (not that moisture is by any means the *cause*, in the way Dr Darwin supposes); but in the latter, becoming sensible, in some unknown way, of the want of this necessary nourishment, they instantly began to make efforts to obtain it by turning upwards. But if they can thus, when their necessities require it, turn upwards in direct opposition to their ordinary course, and to the power of gravity, they must surely be endowed with some force different from, and more powerful, than that of gravitation.

2. Having thus found that the radicle of a seed was capable of turning itself upwards, and in opposition to gravity, it was my object to learn if its direction might not also be totally inverted by the same means; having effected which, by centripetal motion, seems to be the principal fact on which Mr Knight founds his theory. The result of the 5th experiment shews that this is possible.

3. It is, I think, evident, from these experiments, that although a radicle, when first protruded, endeavours always to go downwards (even if surrounded with water), it is, nevertheless, when its necessities require it, capable of exerting some power by which its direction is totally inverted; and that as this motion is directly contrary to the agency of gravity, the power of the radicle which overcomes it must be greater, and therefore distinct from it. It may, however, still be maintained by some, that the ordinary downward direction is owing to

this physical cause alone. But to this, I think, it may be answered, 1*st*, That it is scarcely probable, if the radicle is endowed with a specific power, so active under particular circumstances, that its ordinary and more important direction downwards, is left to a mere physical cause, whilst the other power is totally inactive. 2*dly*, I have seen the radicle of a bean of less specific gravity than water, and, in that case, I should think the pea ought to *ascend* if immersed in water. 3*dly*, A radicle, in the 6th and 7th experiments, even whilst *descending*, appears to raise, or at least resist a weight, probably considerably greater than its own when *under water*, and, therefore, more than the actual amount of the cause to which the effect is assigned.

4. The power of the radicle, which I have thus endeavoured to show to be distinct from gravitation, I can alone ascribe to vegetable life. What is the nature of this supposed vital action, or in what way it operates, I am totally unable to explain, nor is it my object here to propose any new theory, to explain this phenomenon of germination?

If what has been advanced has rendered it probable that these motions do not depend on mere physical causes, but are truly vital actions, it can only be considered as in some measure clearing away the obstacles to the future prosecution of this subject, which still remains an interesting field for future inquiry.

M. Du Hamel made many attempts to oblige the plume and radicle to assume directions contrary to the usual course of nature *. In one instance, an acorn was fixed between two wet sponges, so that the radicle was upwards, and the plume downwards; but this expedient was not successful. The experiments which I have described not only prove the possibility of this, the radicle of a mustard-seed having been made to grow upwards into a sponge (Exper. V.); but appear also to show why this indefatigable experimenter failed in this and other similar experiments.

EDINBURGH, *January* 22. 1829.

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* System of Physiol. Botany, by the Rev. P. Keith, vol. ii. p. 23.

## *Report of* Mr W. E. Cormack's *Journey in Search of the Red Indians in Newfoundland. Read before the Bœothick Institution at St John's, Newfoundland.* Communicated by Mr Cormack.

Pursuant to special summons, a meeting of this Institution was held at St John's on the 12th day of January 1828; the Honourable A. W. Desbarres, Vice-Patron, in the chair. The Honourable Chairman stated, that the primary motive which led to the formation of the Institution, was the desire of opening a communication with, and promoting the civilization of, the Red Indians of Newfoundland; and of procuring, if possible, an authentic history of that unhappy race of people, in order that their language, customs and pursuits, might be contrasted with those of other tribes of Indians and nations;—that in following up the chief object of the institution, it was anticipated that much information would be obtained respecting the natural productions of the island; the interior of which is less known than any other of the British possessions abroad. Their excellent President, keeping all these objects in view, had permitted nothing worthy of research to escape his scrutiny, and consequently a very wide field of information was now introduced to their notice, all apparently highly interesting and useful to society, if properly cultivated. He was aware of their very natural anxiety to hear from the president an outline of his recent expedition, and he would occupy their attention farther, only by observing, that the purposes of the present meeting would be best accomplished by taking into consideration the different subjects recommended to them in the president's report, and passing such resolutions as might be considered necessary to govern the future proceedings of the Institution.

The President, W. E. Cormack, Esq. then laid the following statement before the meeting.

Having so recently returned, I will now only lay before you a brief outline of my expedition in search of the Bœothicks or Red Indians, confining my remarks exclusively to its primary object. A detailed report of the journey will be prepared, and submitted to the institution, whenever I shall have leisure to arrange the other interesting materials which have been collected.

My party consisted of three Indians, whom I procured from among the other different tribes, viz. an intelligent and able man of the Abenakie tribe, from Canada; an elderly Mountaineer from Labrador; and an adventurous young Micmack, a native of this island, together with myself. It was difficult to obtain men fit for the purpose, and the trouble attending on this prevented my entering on the expedition a month earlier in the season. It was my intention to have commenced our search at White Bay, which is nearer the northern extremity of the island than where we did, and to have travelled southward. But the weather not permitting to carry my party thither by water, after several days delay, I unwillingly changed my line of route.

On the 31st of October 1828 last, we entered the country at the mouth of the River Exploits, on the north side, at what is called the Northern Arm. We took a north-westerly direction, to lead us to Hall's Bay, which place we reached through an almost uninterrupted forest, over a hilly country, in eight days. This tract comprehends the country interior from New Bay, Badger Bay, Seal Bay, &c.; these being minor bays, included in Green or Notre Dame Bay, at the north-east part of the island, and well-known to have been always heretofore the summer residence of the Red Indians.

On the fourth day after our departure, at the east end of Badger Bay-Great Lake, at a *portage* known by the name of the Indian Path, we found traces made by the Red Indians, evidently in the spring or summer of the preceding year. Their party had had two canoes; and here was a *canoe-rest*, on which the daubs of red-ochre, and the roots of trees used to fasten or tie it together appeared fresh. A canoe-rest, is simply a few beams supported horizontally about five feet from the ground, by perpendicular posts. A party with two canoes, when descending from the interior to the sea-coast, through such a part of the country as this, where there are troublesome portages, leave one canoe resting, bottom up, on this kind of frame, to protect it from injury by the weather, until their return. Among other things which lay strewed about here, were a spear-shaft, eight feet in length, recently made and ochred; parts of old canoes, fragments of their skin-dresses, &c. For some distance around, the trunks of many of the birch, and of that species of spruce pine called here the Var (*Pinus balsamifera*) had been rinded; these people using the inner part of the bark of that kind of tree for food. Some of the cuts in the trees with the axe, were evidently made the preceding year. Besides, these we were elated by other encouraging signs. The traces left by the Red Indians are so peculiar, that we were confident those we saw here were made by them.

This spot has been a favourite place of settlement with these people. It is situated at the commencement of a *portage*, which forms a communication by a path between the sea-coast at Badger Bay, about eight miles to the north-east, and a chain of lakes extending westerly and southerly from hence, and discharging themselves by a rivulet into the River Exploits, about thirty miles from its mouth. A path also leads from this place to the lakes, near New Bay, to the eastward. Here are the remains of one of their villages, where the vestiges of eight or ten winter *mamateeks* or wigwams, each intended to contain from six to eighteen or twenty people, are distinctly seen close together. Besides these, there are the remains of a number of summer wigwams. Every winter wigwam has close by it a small square-mouthed or oblong pit, dug into the earth, about four feet deep, to preserve their stores, &c. in. Some of these pits were lined with birch rind. We discovered also in this village the remains of a vapour-bath. The method used by the Bœothicks to raise the steam, was by pouring water on large stones made very hot for the purpose, in the open air, by burning a quantity of wood around them; after this process, the ashes were removed, and a hemispherical frame-work closely covered with skins, to exclude the external air, was fixed over the stones. The patient then crept in under the skins, taking with him a birch-rind-bucket of water, and a small bark-dish to dip it out, which, by pouring on the stones, enabled him to raise the steam at pleasure*.

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* Since my return, I learn from the captive Red Indian woman *Shawnawdithit*, that the vapour-bath is chiefly used by old people, and for rheumatic affections.

*Shawnawdithit* is the survivor of three Red Indian females, who were taken by, or rather who gave themselves up, exhausted with hunger, to some English furriers, about five years ago, in Notre Dame Bay. She is the only one of that tribe in the hands of the English, and the only one that has ever lived so long among them. It appears extraordinary, and it is to be regretted, that this woman has not been taken care of, nor noticed before, in a manner which the peculiar and interesting circumstances connected with her tribe and herself would have led us to expect.

At Hall's Bay we got no useful information, from the three (and the only) English families settled there. Indeed we could hardly have expected any; for these, and such people, have been the unchecked and ruthless destroyers of the tribe, the remnant of which we were in search of. After sleeping one night in a *house*, we again struck into the country to the westward.

In five days we were on the high lands south of White Bay, and in sight of the high lands east of the Bay of Islands, on the west coast of Newfoundland. The country south and west of us was low and flat, consisting of marshes, extending in a southerly direction more than thirty miles. In this direction lies the famous Red Indians' Lake. It was now near the middle of November, and the winter had commenced pretty severely in the interior. The country was every where covered with snow, and, for some days past, we had walked over the small ponds on the ice. The summits of the hills on which we stood had snow on them, in some places, many feet deep. The deer were migrating from the rugged and dreary mountains in the north, to the low mossy barrens, and more woody parts in the south; and we inferred, that if any of the Red Indians had been at White Bay during the past summer, they might be at that time stationed about the borders of the low tract of country before us, at the *deer-passes*, or were employed somewhere else in the interior, killing deer for winter provision. At these passes, which are particular places in the migration lines of path, such as the extreme ends of, and straights in, many of the large lakes, —the foot of valleys between high or rugged mountains,—fords in the large rivers, and the like,—the Indians kill great numbers of deer with very little trouble, during their migrations. We looked out for two days from the summits of the hills adjacent, trying to discover the smoke from the camps of the Red Indians; but in vain. These hills command a very extensive view of the country in every direction.

We now determined to proceed towards the Red Indians' Lake, sanguine that, at that known rendezvous, we would find the objects of our search.

Travelling over such a country, except when winter has fairly set in, is truly laborious.

In about ten days we got a glimpse of this beautifully majestic and splendid sheet of water. The ravages of fire, which we saw in the woods for the last two days, indicated that man had been near. We looked down on the lake, from the hills at the northern extremity, with feelings of anxiety and admiration:—No canoe could be discovered moving on its placid surface, in the distance. We were the first Europeans who had seen it in an unfrozen state, for the three former parties who had visited it before, were here in the winter, when its waters were frozen and covered over with snow. They had reached it from below, by way of the river Exploits, on the ice. We approached the lake with hope and caution; but found to our mortification that the Red Indians had deserted it for some years past. My party had been so excited, so sanguine, and so determined to obtain an interview of some kind with these people, that, on discovering from appearances every where around us, that the Red Indians,—the terror of the Europeans as well as the other Indian inhabitants of Newfoundland,—no longer existed, the spirits of one and all of us were very deeply affected. The old mountaineer was particularly overcome. There were every where indications, that this had long been the central and undisturbed rendezvous of the tribe, when they had enjoyed peace and security. But these primitive people had abandoned it, after having been tormented by parties of Europeans during the last 18 years. Fatal rencounters had on these occasions unfortunately taken place.

We spent several melancholy days wandering on the borders of the east end of the lake, surveying the various remains of what we now contemplated to have been an unoffending and cruelly extirpated people. At several places, by the margin of the lake, are small clusters of winter and summer wigwams in ruins. One difference, among others, between the Bœothick wigwams and those of the other Indians, is, that in most of the former there are small hollows, like nests, dug in the earth around the fire-place, one for each person to sit in. These hollows are generally so close together, and also so close to the fire-place, and to the sides of the wigwam, that I think it probable these people have been accustomed to sleep in a sitting position. There was one wooden building constructed for drying and smoking venison in still perfect; also a small log-house, in a dilapidated condition, which we took to have been once a store-house. The wreck of a large handsome birch-rind canoe, about twenty-two feet in length, comparatively new, and certainly very little used, lay thrown up among the bushes at the beach. We supposed that the violence of a storm had rent it in the way it was found, and that the people who were in it had perished; for the iron nails, of which there was no want, all remained in it. Had there been any survivors, nails being much prized by these people, they never having held intercourse with Europeans, such an article would most likely have been taken out for use again. All the birch trees in the vicinity of the lake had been rinded, and many of them and of the spruce fir or var (*Pinus balsamifera*, Canadian balsam tree) had the bark taken of, to use the inner part of it for food, as noticed before.

Their wooden repositories for the dead are what are in the most perfect state of preservation. These are of different constructions, it would appear, according to the character or rank of the persons entombed. In one of them, which resembled a hut ten feet by eight or nine, and four or five feet high in the centre, floored with squared poles, the roof covered with rinds of trees, and in every way well secured against the weather inside, and the intrusion of wild beasts, there were two grown persons laid out at full length, on the floor, the bodies wrapped round with deer-skins. One of these bodies appeared to have been placed here not longer ago than five or six years. We thought there were children laid in here also. On first opening this building, by removing the posts which formed the ends, our curiosity was raised to the highest pitch; but what added to our surprise, was the discovery of a white deal coffin, containing a skeleton neatly shrouded in white muslin. After a long pause of conjecture how such a thing existed here, the idea of *Mary March* occurred to one of the party, and the whole mystery was at once explained *.

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* It should be remarked here, that Mary March, so called from the name of the month in which she was taken, was the Red Indian female who was captured and carried away by force from this place by an armed party of English people, nine or ten in number, who came up here in the month of March 1809. The local government authorities at that time did not foresee the result of offering a reward to *bring a Red Indian to them*. Her husband was cruelly shot, after nobly making several attempts, single-handed, to rescue her from the captors, in defiance of their fire-arms and fixed bayonets. His tribe built this cemetery for him, on the foundation of his own wigwam, and his body is one of those now in it. The following winter, Captain Buchan was sent to the River Exploits, by order of the local government of New-

In this cemetery were deposited a variety of articles, in some instances the property, in others the representations of the property and utensils, and of the achievements, of the deceased. There were two small wooden images of a man and woman, no doubt meant to represent husband and wife; a small doll, which we supposed to represent a child (for *Mary March* had to leave her only child here, which died two days after she was taken): several small models of their canoes; two small models of boats; an iron axe; a bow and quiver of arrows were placed by the side of *Mary March's* husband; and two fire-stones (radiated

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foundland, to take back this woman to the lake, where she was captured, and if possible, at the same time, to open a friendly intercourse with her tribe. But she died on board Captain B.'s vessel, at the mouth of the river. Captain B., however, took up her body to the lake; and not meeting with any of her people, left it where they were afterwards likely to meet with it. It appears the Indians were this winter encamped on the banks of the River Exploits, and observed Captain B.'s party passing up the river on the ice. They retired from their encampments in consequence; and, some weeks afterwards, went by a circuitous route to the lake, to ascertain what the party had been doing there. They found *Mary March's* body, and removed it from where Captain B. had left it to where it now lies, by the side of her husband.

With the exception of Captain Buchan's first expedition, by order of the local government of Newfoundland in the winter of 1810, to endeavour to open a friendly intercourse with the Red Indians, the two parties just mentioned are the only two we know of that had ever before been up to the Red Indian Lake. Captain B. at that time succeeded in forcing an interview with the principal encampment of these people. All of the tribe that remained at that period were then at the Great Lake, divided into parties, and in their winter encampments, at different places in the woods on the margin of the lake. Hostages were exchanged; but Captain B. had not been absent from the Indians two hours, in his return to a depot left by him at a short distance down the river, to take up additional presents for them, when the want of confidence of these people in the whites evinced itself. A suspicion spread among them that he had gone down to bring up a reinforcement of men, to take them all prisoners to the sea coast; and they resolved immediately to break up their encampment and retire farther into the country, and alarm and join the rest of their tribe, who were all at the western parts of the lake. To prevent their proceedings being known, they killed and then cut off the heads of the two English hostages; and, on the same afternoon on which Captain B. had left them, they were in full retreat across the lake, with baggage, children, &c. The whole of them afterwards spent the remainder of the winter together, at a place twenty to thirty miles to the south-west, on the south-east side of the lake. On Captain B.'s return to the lake next day or the day after, the cause of the scene there was inexplicable; and it remained a mystery until now, when we can gather some facts relating to these people from the Red Indian woman *Shawnawdithit.*

iron pyrites, from which they produce fire, by striking them together) lay at his head; there were also various kinds of culinary utensils, neatly made, of birch rind, and ornamented; and many other things, of some of which we did not know the use or meaning.

Another mode of sepulture which we saw here was, where the body of the deceased had been wrapped in birch rind, and with his property, placed on a sort of scaffold about four feet and a half from the ground. The scaffold was formed of four posts, about seven feet high, fixed perpendicularly in the ground, to sustain a kind of crib, five feet and a half in length by four in breadth, with a floor made of small squared beams, laid close together horizontally, and on which the body and property rested.

A third mode was, when the body, bent together, and wrapped in birch rind, was enclosed in a kind of box, on the ground. The box was made of small squared posts, laid on each other horizontally, and notched at the corners, to make them meet close; it was about four feet by three, and two and a half feet deep, and well lined with birch rind, to exclude the weather from the inside. The body lay on its right side.

A fourth and the most common mode of burying among these people, has been, to wrap the body in birch rind, and cover it over with a heap of stones, on the surface of the earth, in some retired spot; sometimes the body, thus wrapped up, is put a foot or two under the surface, and the spot covered with stones; in one place, where the ground was sandy and soft, they appeared to have been buried deeper, and no stones placed over the graves.

These people appear to have always shewn great respect for their dead; and the most remarkable remains of them commonly observed by Europeans at the sea-coast, are their burying-places. These are at particular chosen spots; and it is well known that they have been in the habit of bringing their dead from a distance to them. With their women they bury only their clothes.

On the north side of the lake, opposite the River Exploits, are the extremities of two deer fences, about half a mile apart, where they lead to the water. It is understood that they diverge many miles in north-westerly directions. The Red Indian makes these fences to lead and scare the deer to the lake, during the periodical migration of these animals; the Indians being stationed looking out, when the deer get into the water to swim across, the lake being narrow at this end, they attack and kill the animals with spears out of their canoes. In this way they secure their winter provisions before the severity of that season sets in.

There were other old remains of different kinds peculiar to these people met with about the lake.

One night we encamped on the foundation of an old Red Indian wigwam, on the extremity of a point of land which juts out into the lake, and exposed to the view of the whole country around. A large fire at night is the life and soul of such a party as ours, and when it blazed up at times, I could not help observing that two of my Indians evinced uneasiness and want of confidence in things around, as if they thought themselves usurpers on the Red Indian territory. From time immemorial none of the Indians of the other tribes had ever encamped near this lake fearlessly, and, as we had now done, in the very centre of such a country; the lake and territory adjacent having been always considered to belong exclusively to the Red Indians, and to have been occupied by them. It had been our invariable practice hitherto, to encamp near hills, and be on their summits by the dawn of day, to try to discover the morning smoke ascending from the Red Indians' camps; and to prevent the discovery of ourselves, we extinguished our own fire always some length of time before day-light.

Our only and frail hope now left of seeing the Red Indians, lay on the banks of the River Exploits, on our return to the sea-coast.

The Red Indians' Lake discharges itself about three or four miles from its north-east end, and its waters form the River Exploits. From the lake to the sea-coast is considered about seventy miles; and down this noble river the steady perseverance and intrepidity of my Indians carried me on rafts in four days, to accomplish which otherwise, would have required, probably, two weeks. We landed at various places on both banks of the river on our way down, but found no traces of the Red Indians so recent as those seen at the portage at Badger Bay-Great Lake, towards the beginning of our excursion. During our descent, we had to construct new rafts at the different waterfalls. Sometimes we were carried down the rapids at the rate of ten miles an hour or more, with considerable risk of destruction to the whole party, for we were always together on one raft.

What arrests the attention most, while gliding down the stream, is the extent of the Indian fences to entrap the deer. They extend from the lake downwards, continuous, on the banks of the river, at least thirty miles. There are openings left here and there in them, for the animals to go through and swim across the river, and at these places the Indians are stationed, and kill them in the water with spears, out of their canoes, as at the lake. Here, then, connecting these fences with those on the north-west side of the lake, is at least forty miles of country, easterly and westerly, prepared to intercept all the deer that pass that way in their periodical migrations. It was melancholy to contemplate the gigantic, yet feeble, efforts of a whole primitive nation, in their anxiety to provide subsistence, forsaken and going to decay.

There must have been hundreds of the Red Indians, and that not many years ago, to have kept up these fences and pounds. As their numbers were lessened so was their ability to keep them up for the purposes intended; and now the deer pass the whole line unmolested.

We infer, that the few of these people who yet survive have taken refuge in some sequestered spot, still in the northern part of the island, and where they can procure deer to subsist on.

On the 29th November we were again returned to the mouth of the River Exploits, in thirty days after our departure from thence, after having made a complete circuit of about 200 miles in the Red Indian territory.

I have now stated generally the result of my excursion, avoiding, for the present, entering into any detail. The materials collected on this, as well as on my excursion across the interior a few years ago, and on other occasions, put me in possession of a general knowledge of the natural condition and productions of Newfoundland; and, as a member of an institution formed to protect the aboriginal inhabitants of the country in which we live, and to prosecute inquiry into the moral character of man in his primitive state, I can, at this early stage of our institution, assert, trusting to nothing vague, that we already possess more information concerning these people than has been obtained during the two centuries and a-half in which Newfoundland has been in the possession of Europeans. But it is to be lamented that now, when we have taken up the cause of a barbarously treated people, so few should remain to reap the benefit of our plans for their civilization. The institution and its supporters will agree with me, that, after the unfortunate circumstances attending past encounters between the Europeans and the Red Indians, it is best now to employ Indians belonging to the other tribes to be the medium of beginning the intercourse we have in view; and, indeed, I have already chosen three of the most intelligent men from among the others met with in Newfoundland, to follow up my search.

In conclusion, I congratulate the institution on the acquisition of several ingenious articles, the manufacture of the *Bœothicks*, some of which we had the good fortune to discover on our recent excursion;—models of their canoes, bows and arrows, spears of different kinds, &c. and also a complete dress worn by that people. Their mode of kindling fire is not only original, but, as far as we at present know, is peculiar to the tribe. These articles, together with a short vocabulary of their language, consisting of 200 to 300 words, which I have been enabled to collect, prove the Bœothicks to be a distinct tribe from any hitherto discovered in North America. One remarkable characteristic of their language, and in which it resembles those of Europe more than any other Indian languages do, with which we have had an opportunity of comparing it,—is its abounding in diphthongs. In my detailed report, I would propose to have plates of these articles, and also of the like articles used by other tribes of Indians, that a comparative idea may be formed of them; and, when the Indian female *Shawnawdithit* arrives in St John's, I would recommend that a correct likeness of her be taken, and be preserved in the records of the institution. One of the specimens of mineralogy which we found in our excursion, was a block of what is called *Labrador Felspar*, nearly 4½ feet in length, by about three feet in breadth and thickness. This is the largest piece of that beautiful rock yet discovered any where. Our subsistence in the interior was entirely animal food, deer and beavers, which we shot.

" *Resolved*,—That the measures recommended in the president's report be agreed to; and that the three men, Indians of the Canadian and Mountaineer tribes, be placed upon the establishment of this institution, to be employed under the immediate direction and control of the president; and that they be allowed for their services such a sum of money as the president may consider a fair and reasonable compensation: That it be the endeavour of this institution to collect every useful information respecting the natural productions and resources of this island, and, from time to time, to publish the same in its reports: That the instruction of *Shawnawdithit* would be much accelerated by bringing her to St John's, &c: That the proceedings of the institution since its establishment be laid before his Majesty's Secretary of State for the Colonial Department, by the president, on his arrival in England.

(Signed) "A. W. des BARRES,
Chairman and Vice-Patron."

## *Observations on the Geology of the Meywar District.* By JAMES HARDIE, Esq. Member of the Medical and Physical Societies of Calcutta.* Communicated by the Author.

MEYWAR is included between the latitudes 26° and 24° north, and longitudes $73\frac{1}{2}°$ and $75\frac{1}{2}°$ east.

The country, towards the south, is extremely hilly; and this portion of it includes the Bheel jungles, and the small district of Kurrock. Towards the north, there are plains of large extent, from the surface of which are seen rising several ranges of hills and detached mountains. These rise abruptly from the surface; and there is scarcely such a thing as a deep valley, or, indeed, a valley properly so called, in the whole of this portion of the district. There is one principal range of mountains which traverses the whole of the western part of Meywar. It commences high up in the district of Ajmeer, and proceeds southward till it is lost in the gauts north of the Vindyan range. Besides this, there is the Cheetore range, which separates Meywar and Malwa from Harowtee.

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* Captain Dangerfield's report on the Geology of Malwah, in the appendix to Sir John Malcolm's Memoir of Central India, includes also an account of the geology of a part of the Meywar district; and his small geological map will assist our readers in understanding Mr Hardie's observations.

The hills in Meywar, and in the neighbouring primitive district of Ajmeer, Jeypore, &c. and, I may add, in all this part of India, are low, never rising higher than 1000 or 1100 feet above the neighbouring plain. They are rarely seen so high; and are very frequently as low as four, five, or six hundred feet. If we calculate their height, however, from the level of the sea, they will hold a more respectable rank in the scale of mountains; the plain itself having an altitude, above the level of the sea, of 1400 or 1500 feet.

The southern portion may be described as consisting of a series of mountain groups, closely studded together, and separated from each other by narrow and deep valleys. These valleys are very fertile; and although most miserably cultivated, they afford sufficient food to supply the wants of the inhabitants. In the article of water, they are sadly deficient, and are obliged to rely on the rains for their annual supply of this necessary of life. The consequence is, that in years when the usual supply does not fall, they are exposed to all the miseries of famine, from the entire failure of their crops. The country has a wild and bleak appearance, and is admirably adapted for the concealment and shelter of the predatory tribes by which it is inhabited. It is intersected by numerous deep ravines (gauts), on the sides of which are seen rising, over the brinks of precipices, the villages and houses of this rude people.

The rocks, which we observe in this southern portion, are all decidedly primitive, being placed nearly in the centre of a primitive tract of no great breadth, which extends northward through Ajmeer, and southward towards the valley of the Nerbuddah; but how far south, I am not exactly aware. The portion of the district, which we are now describing, is bounded on the east by the table land of Malwah, which is an immense secondary trap formation, exhibiting, in some situations, columns of a very pure basalt, in others, trap-tufa, and in others again, a rock deeply impregnated with iron. I am not aware of the exact nature of the rocks towards the west; but, from all that I can learn, it is of secondary formation; and I have seen several beautiful specimens of a shell marble brought from a district to the north-west. To the south-west, again, we have alluvial formations. These boundaries are, of course, purely geological; and although they include much more than the district which I myself have seen, yet the following remarks derived from all that I have heard upon the subject, and from the specimens I have examined, will apply pretty generally to the whole.

The rocks which principally occur in the southern portion of the district are mica, clay, and chlorite slates, quartz rock, serpentine (of which very beautiful tables and other ornaments are fabricated), granite, gneiss, and syenite. These rocks pass into each other by insensible gradations, so that it is often difficult to determine to which formation they belong. Quartz-rock is of very frequent occurrence, and very often forms entire hills. It varies much in its texture in different situations. The finest variety is in the form of a white very compact rock, which is indistinctly stratified, and which contains imbedded masses of a nearly transparent variety. From this to the clay-slate there appears to be a regular gradation. The quartz, in other situations, passes into gneiss and mica-slate. This is more particularly observable in the neighbourhood of the Dhabar lake, and in other situations hereafter to be mentioned.

A striking feature in very many of the hills in this district, and, indeed, throughout Meywar, is derived from the occurrence of a thin bed of quartz rock of a pure white colour, and seldom more than two or three feet in thickness, which is observed running along their ridges, throughout their whole extent, and forming a sharp angle, from which the darker coloured and softer clay-slate slopes on either side.

In correspondence with the diversity and hardness of the rocks in this district, we have a diversity in the shape of the hills. The ridge-shape is the most common; and from the sharpness of the angle, and the regularity of the outline formed by the quartz-rock, as above described, their summit appears, in the distance, to be occupied by a table-land. The deception is increased by their frequently assuming the appearance of a truncated cone. In this variety, the sharp ridge still exists. It is continued, for some distance, in a line parallel to the horizon, and then suddenly slopes at a very acute angle. Frequently, too, we have the appearance of denticulated ridges; and in many situations, peaks, often of fantastic forms, are seen rising above the neighbouring hills. Where the quartz appears in its finest form, the hills are much lower than the rest, and then they rather deserve the name of irregularities of the surface, exhibiting, as they do, smooth round swells which are, in many situations, entirely destitute of soil. The white appearance of these, in the distance, is exceedingly striking, presenting to the fancy a resemblance to the snow-covered plains of our native land. Besides the above appearances, numerous mural precipices are seen rising above the jungle which covers the slopes. The hills that present this appearance are generally formed of the distinctly stratified quartz, resting on a clay-slate of a less durable nature; and I particularly remarked that the slope of the hills, in the direction in which the strata dip, is very often, almost entirely, destitute of soil, and presents a bare and barren surface, from which the rays of the sun are reflected with fearful intensity; whereas the other side, where the outgoings of the clay-slate are observed, is covered with vegetation; and the outgoings of the quartz strata, rising immediately above, present the perpendicular face just mentioned.

The serpentine is generally found in low situations; the specimens which I procured having been thrown out in sinking a well.

The wild and rugged aspect of this country, might, at first sight, perhaps lead us to suppose that it must, at various periods, have been subjected to violent convulsions of nature; and we are almost sorry when we discover that many of these appearances can be accounted for on ordinary principles. The mind is naturally fond of the marvellous; and when nature presents herself to us in her wildest forms, our imagination is apt to lead us beyond the bounds which reason has prescribed. The delusion is, however, a pleasant one; and it is often difficult to descend from the high position which our fancy has taken, to the more common, though in truth not less marvellous, realities of life. That violent revolutions have occurred here, as they have done over the whole surface of the globe, there can be no doubt. The deep and rugged ravines, which have obviously not been worn down by the action of water, are sufficient to prove this. The striking features of the country, however, above described, depend on other causes. Not only must the great diversity of the rocks, and the difference which exists among them, as to hardness and durability, be taken into account; but the nature of the climate in which they occur must also be considered.

In the district under consideration, we observe a great difference to exist in the features of the rock; and we see the harder and more durable penetrating as it were through the substance of the softer, and appearing in the form of peaks, denticulated ridges, or the white quartzy ridges described above. It is sufficiently obvious, wherever a bed of a hard rock, as quartz, occurs, associated with strata very liable to be acted on by the atmosphere, rains, &c., that (whatever its previous situation may have been) it will, in the course of time, occupy the highest situation. The appearance of this part of the country is in exact accordance with this principle. But I have said that the climate must be taken into consideration; and there can be no doubt that this operates in rendering the general causes alluded to more powerful.

For three or four months of the year we are exposed to the scorching influence of the hot winds, which blow continually from one quarter, and parch the whole face of the country. During this winter of India (for by no other name can I call it) every thing presents a complete system of desolation and lifelessness. The trees lose their leaves, and vegetation is completely at a stand, except in the instance of the mangoe-tree, and other evergreens. The hills are deprived of their covering; not a shrub, not a green blade of grass, is to be seen, and the animal as well as vegetable creation seems equally to sink under the oppressive heat.

This season is immediately followed by the rains, which, at their commencement, fall in torrents, and are accompanied by tremendous thunder storms. The effect of this deluge on the parched ground may be easily conceived. Immense rents and crevices are formed; and the hill-torrents, which at that time come down with amazing velocity and force, carry before them every thing which opposes their progress. When a considerable quantity of rain has fallen, there is generally a cessation for several days. The crevices and seams, in the soil and rocks, are by this time filled with water, which has now penetrated to a considerable distance from the surface. In this state they are exposed to the burning influence of a nearly vertical sun. The expansion, occasioned by the heat, is of course great. Huge masses of rock are detached, and the progress of decomposition in the soft and slaty rock is carried on with great rapidity. The country we are now considering is peculiarly liable to be affected by the above-mentioned causes; and hence its rugged and broken aspect.

While marching from the small fort of Khariwarrah, near the city of Dangerpore, towards the Bheel village of Bandeo, about twelve miles distant, we observed a formation of quartz-rock, of a very singular nature. It presented, in the distance, the appearance of an irregular crag, rising perpendicularly from the slope of the hills, the summit of which was rugged and uneven. It greatly resembled a ruined fortification, rising through the jungle, and was so striking an object, that even the most careless observer did not fail to remark it as something unusual, even in this wild district, where so many precipices are observed. In approaching nearer, it looks exactly like a huge wall raised artificially, along the ridge of the hill. It presents a perpendicular face on two sides. It follows the course of the slope, reaches the very top, and again descends on the other side of the hill. The average height of the perpendicular face may be between twenty and thirty feet; the breadth of the bed between eighteen and twenty.

On examination, I found that this extraordinary bed was composed of quartz rock of a bluish-grey colour, of a highly crystalline structure, and that it was arranged in nearly horizontal strata. The strata are very distinct, and the rock easily splits into plates of about an inch in thickness. The rock of which the hill itself is composed, is clay-slate of a soft nature, and easily acted on by the weather; and immense masses of it were seen strewing the line of march. All the hills we had passed were composed of a similar rock. It was arranged in nearly *vertical strata* *.

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* The author states, that the bed of quartz-rock, which was included between *vertical strata* of clay-slate, was itself arranged in *horizontal strata*. Was

In regard to the simple minerals of this district, I can give little information, as none of any consequence met my eye, except, indeed, some very beautiful specimens of *rock-crystal*, and some crystals of *amethyst*, of no great value. *Garnets*, also, were seen in great quantities in the dried-up beds of rivulets, and these had obviously been washed down from the gneiss and mica-slate formations, in which rocks they were of frequent occurrence. *Steatite* was also common in the granites. Neither can I give any satisfactory account of the metals. I have no doubt, however, that if this district were properly explored, many rich metallic veins might be discovered. There are several iron founderies in the district; and at a village named Jowar, about twelve miles from Oudeypore, lead occurs in considerable quantities. It is associated with quartz strata, and several years ago it was worked to great advantage, not only for the sake of the lead, but also of the silver which is found with it. The natives indeed state, that it was exceedingly rich in silver, and that a bullock-load of it was yearly presented to the ranah by the renter, as a present, in addition to the rent which he paid. It seems now to be exhausted, and the mine is worked solely for the lead, although specimens in which silver occurs are still found.

this appearance of horizontal stratification not rather owing to those natural joints which so frequently occur in quartz rocks? We are the more inclined to this opinion, from its being in accordance with Captain Dangerfield's observations on the quartz-rock of this district. Talking of two quartz-hills in the neighbourhood of Maunpoor, he says: "From the division of this rock into *vertical and horizontal* fissures, arises a singular wall-like structure, and an angular wild outline, and castellated appearance, which, with its brilliant white colour, contrasted with the sombre hue of the slates, makes these hills at a distance resemble snowy peaks, rising from amidst desolation and disorder." *Vide* Sir John Malcom's *Memoir of Central India*, Appendix, No. II.

*(To be continued.)*

## *Observations on the Reproduction of Domestic Fowls.* By M. Girou de Buzareingues.

From the facts which I have had the honour of communicating to the Academy, there results, that in the domestic Mammifera, the too young and too old females, as well as those which are ill fed, or of weak constitution, or subjected to laborious exercises at the period of copulation, produce in general a greater number of males than those which are middle-aged and in a fine state of vigour and health, especially if the latter are covered by vigorous males of strong constitution and middle-aged, and the former by too young or old males, or such as are of feeble constitution.

It appeared to me interesting to know if this was also the case in domestic fowls, and although I have not yet obtained enough of facts from my experiments to solve the question, the Academy will perhaps be induced by the importance of the subject to receive what I have obtained.

Rozier has asserted his having observed in turkeys that, when the animal has issued from the egg, and several days after, the female is larger than the male, and has added, that, by following this indication, one need not be deceived as to the sex of these birds. But facts only prove that, among the largest of newly hatched turkeys, there are somewhat more females than males; and this is the only fact which I have yet obtained from my observations on the reproduction of these birds: for the humidity of the last month of May, which thwarted me much in all my experiments, destroyed at least three-fourths of my turkeys, before I could determine their sex.

I have not been more fortunate in my experiments on ducks' eggs, an accident having deprived me of all my ducklings immediately after they were hatched.

The common hen, in short, has furnished the only observations which deserve to be mentioned.

I wished to know whether large or small, long or short eggs, yield most males or females.

I could only compare together the eggs produced in the same poultry yard; for the eggs which seem large in one place appear small in another, on account of the difference of the races, which is determined by that of the food.

It is only by their weight that the volume of eggs can always be judged of; for the largest often weigh less than the smallest, when they have not been laid at the same period, on account of the evaporation of the humid part. They ought, therefore, to be measured; and the most accurate measure is that obtained by the displacement of water, the weight of which may, for more convenience, represent the volume of the body which has displaced it.

However, in 1826, I weighed the eggs themselves, after separating the larger from the smaller, and the weights obtained confirmed my ideas as to the relative volume.

In 1827 I proceeded in the following manner: After forming the courses by bringing together the eggs which appeared the largest, and afterwards the smallest, I immersed at once all the eggs of the same course in a vessel exactly filled with water, and placed in another empty vessel. The water which, by this immersion, passed into the second vessel was accurately weighed, and its weight represented the total volume of the course. On dividing this weight by the number of eggs, I obtained a mean representation of volume for each egg.

To avoid all confusion, I make particular marks with ink on each of the courses. I marked the chickens the moment they were hatched, by cutting off one of their claws. This mode of marking is very simple, but care must be taken to renew it every fortnight, for the cut claw sprouts, and at length does not differ from the rest. From having neglected this precaution in marking the young of certain broods, which I placed together under the charge of the same hen, I found it impossible to distinguish them again, and was thus deprived of the result of part of my labours.

I opened the abdomen of the chickens which died, in order to discover the sex, when they had not yet exhibited any external marks. I kept very accurate notes of all, and here give the general results.

## EXPERIMENTS OF 1826.

### DEMESNE OF GOUDALIE.

| | Males. | Fem. |
|---|---|---|
| 30 hens' eggs, of a spherical form, and of the mean weight of 54.33 gr., yielded - - - | 15 | 15 |
| 60 hens' eggs, of an elongated form, and of the same weight as the preceding, yielded - - | 30 | 30 |
| 8 eggs of a spherical form, and of the weight of 47.56 gr., yielded - - - - | 7 | 1 |

### DEMESNE OF BUZAREINGUES.

| | Males. | Fem. |
|---|---|---|
| 60 turkeys' eggs, of the mean weight of 69.50 gr., produced by females one year old, and of small size, yielded - - - - - - | 40 | 20 |

## EXPERIMENTS OF 1827.

### DEMESNE OF BAZAREINGUES.

| Dates of Incubation. | Number of products whose sex was determined. | Mean weight of water displaced by each egg. | Males. | Females. | OBSERVATIONS. |
|---|---|---|---|---|---|
| June 6. | 16 | 40.76 gr. | 9 | 7 | |
| May 21. | 22 | 41.15 | 14 | 8 | Hatched 11th June, noon. |
| May 14. | 16 | 43.68 | 9 | 7 | Hatched 4th June. |
| March 28. | 13 | 44.64 | 6 | 7 | |
| June 6. | 6 | 45.44 | 5 | 1 | |
| May 21. | 20 | 46.52 | 10 | 10 | Hat. 11th June, aftern. |
| June 6. | 5 | 46.88 | 1 | 4 | |
| May 14. | 17 | 47.04 | 8 | 9 | Hatched 5th June. |
| June 6. | 10 | 53.00 | 4 | 6 | |
| | DEMESNE OF LECURE *. | | | | |
| May 13. | 11 | 49.20 | 8 | 3 | |
| April 22. | 10 | 50.93 | 6 | 4 | |

* The hens of this demesne are larger than those of Buzareingues.

In the latter demesne, a third course, the eggs of which were to appearance larger than those of the first, and smaller than those of the second, yielded 6 males and 3 females; and a fourth course, the eggs of which were laid by a tufted hen, the favourite of the mistress of the house, and consequently well fed, produced 5 males and 7 females.

The total of these different broods is 183 males and 152 females.

If these results are confirmed by new and numerous experiments, as the volume of the eggs is in relation with that of the birds, it will be established, 1st, That, in the same poultry yard, and under the same race of fowls, the larger females produce a greater proportional number of females than the smaller; 2dly, That there is no certain relation between the sex of the chicken and the form of the egg; 3dly, That the small eggs are longer in being hatched than the large; 4thly, That in the gallinaceæ the predominance of the male sex is greater than in the mammifera.

Old hens lay large eggs, and if birds obey the same laws of reproduction as the mammifera, these eggs ought to yield as many males as the smallest. Now, it will be remarked that the predominance of the males furnished by the small eggs is greater than that of the females furnished by the large eggs. It may also be remarked, that the very young females which have not acquired a precocious developement, yield a great proportional number of males. It is therefore probable, that the same laws of reproduction are common to the mammifera and to birds.

The comparative trial of round eggs and long eggs was made by my orders, but not under my inspection; and, although I do not view the results with suspicion, I cannot warrant them.

Some facts seem to prove, that, according to the common opinion of housewives, it is not a matter of indifference to lay down eggs for hatching under all the phases of the moon, and that the result is so much the more satisfactory, the nearer the exclusion is to the time of full moon. All the courses of the demesne of Buzareingues, in 1827, were composed of 25 eggs. Now, as may be seen from the above table, the success of these hatchings has been in the following order: 1st, Those of the 21st May; 2d, Those of the 14th May; 3d, Those of the 28th March; 4th, Those of the 6th June. The exclusion of the first took place on the 16th of the moon, of the second on the 10th, of the third on the 21st, and of the fourth on the 4th. The intervals between these periods and full moon, are 2, 4, 7, and 10 days. Might not these relations, if they are constant, be the effects of the influence of light or darkness on the state of agitation or rest of the hen? By too much heat, the hen's sitting constantly kills the young, or thwarts their developement.

I intend to continue my experiments on this subject, and the facts which I obtain, whatever they may happen to be, will be made known to the Academy.

*Annales des Sciences Naturelles.*

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## 1. *Description of an Improved Blowpipe*; 2. *On the Ascent of Mercury on Wires of Iron*; 3. *Experiments on the Electro-magnetic Properties of Carbon when in a State of Combustion.* By Mr K. T. Kemp. Communicated by the Author.

### 1. *Description of an Improved Blowpipe.*

Permit me, through the medium of your excellent Journal, to bring under the notice of the public an improvement on the blowpipe.

The importance of the blowpipe as an instrument of chemical analysis, and of extensive application in the arts, is so well known, that I do not here require to make a single remark on the subject. It has undergone many modifications, from that of the simple bent tube, to the more efficient instrument when in the form of a hydraulic machine.

All of them, however, either occupy too much space, are not portable, and are too complicated, or, if not, as in the case of the bent tube, they are hurtful to the lungs, and cannot be used but with much inconvenience, from the necessity of keeping up a continued blast.

The one I am now about to describe is very portable, requires almost no exertion of the lungs, one expiration into it being sufficient to produce a continued blast for about two minutes; and it also occupies very little space. It consists of a glass-vessel, of a globular shape A B, Plate V. Fig. 8. into the neck of which a cork is fitted, and made perfectly tight by a sealing of wax; through the cork pass two tubes C *c* and D *d*, about

*Fig 3.*

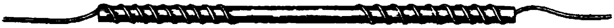


*Fig 4.*

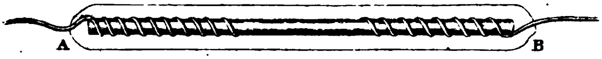


*Fig 5.*

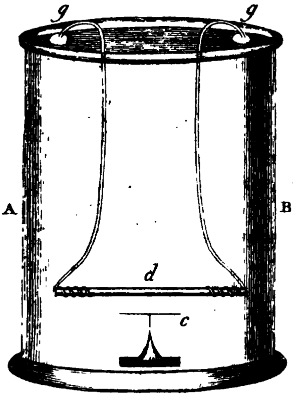


*Fig 8.*

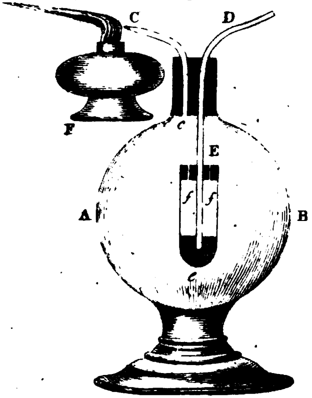


*Fig 6.*

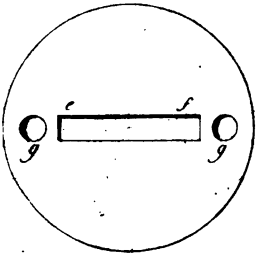


*Fig 2.*

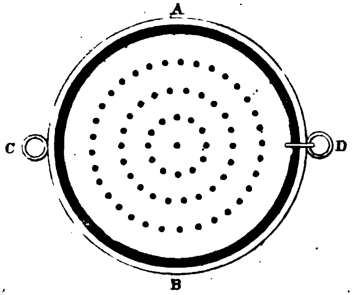


*Fig 1.*

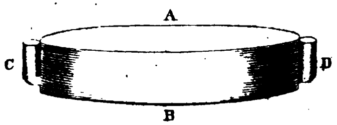


*Fig 9.*

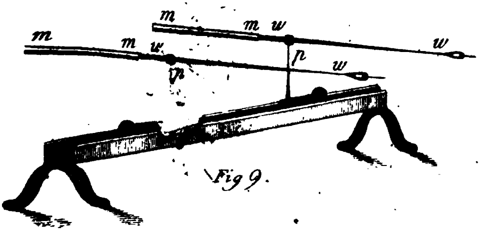
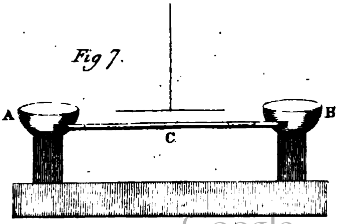


*Fig 7.*



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a quarter of an inch in diameter. The one, C *c*, terminates at the under surface of the cork *c*, and is open into the vessel; it is bent, as shown in the figure, and is brought at its extremity C to a fine point, for emitting a stream of air to urge the flame. The other tube, D *d*, also passes through the cork, and is terminated into a bottle-like tube E *e*, a sufficient space being left between the under part of the tube D *d*, and the bottom of the bottle E *e*, for the passage of the air, which is forced in at the other extremity of the tube at D. The small bottle-like tube E *e* contains a portion of mercury, below the surface of which the tube D*d* terminates, after passing through a cork at the upper part of it E, and to which it is firmly attached by means of a sealing of wax; two small openings *f*, *f*, are cut in the cork, to allow the air to pass freely through, into the large glass-vessel.

A small stand F, for supporting a spirit-lamp, is attached to the neck of the vessel, which may be raised or lowered by a screw, to allow the flame to be acted upon by a stream of air, as it issues from the tube C.

In using this blowpipe, all that is necessary is to adjust the lamp, by means of the screw and stand, till it be opposite the tube C.

If we then blow into the tube D *d*, we will force in a quantity of air, which passing through it, and the mercury contained at the bottom of it, in the bottle E *e*, rises and is forced through the openings *f*,*f* into the large vessel. This additional quantity of air within the vessel, exerts a pressure on the surface of the mercury, and raises a column of it in the tube D *d*, which, acting as a valve, shuts the communication between the internal and external air, and effectually prevents any of it from returning through the tube D *d*, while, at the same time, the condensed air within the glass-vessel, from its greater elasticity, flows through the other tube C upon the flame of the lamp; and as a period of from one to two minutes elapses before it arrives at the density of the atmosphere, a continued stream of air may be made to act on the flame, by occasionally blowing into the tube D, while the operator has the free use of both hands, which is of some importance in experimenting on minute portions of matter.

The instrument may be rendered more perfect, by having a stop-cock placed in the tube C, to regulate the current of air; for most purposes, however, this is unnecessary.

Instead of the tube D *d* being terminated in E *e*, it might have been continued to the bottom of the vessel, and be there terminated in a portion of mercury. This construction would answer equally well, if the instrument was to remain stationary; but, during motion, it sometimes happens that the mercury is removed from the bottom of the tube, and the elasticity of the air acting on that column of mercury within the tube, forces it out at the orifice D.

The same principle of constructing a valve may be applied to the hydraulic blowpipe. The tube coming from the bellows, instead of having a common valve inserted into it, and terminating at the *top* of the air-vessel, may be continued to the *bottom* of it; when, upon the air being forced in by the bellows, it displaces the water from the tube, and rises into the upper part of the air-vessel. The water now acts as a valve, and prevents the return of the air by that tube, while it is forced out by the other tube in the usual manner.

By this plan we obtain a valve of the most simple description, and without the possibility of getting wrong; nor is there a greater pressure required for forcing in the air by this method, than when the tube terminates at the top of the air-vessel through a common valve.

## 2. *Ascent and Combination of Mercury on Metallic Wires.*

While making some experiments with the liquid amalgam of mercury and zinc, upon the other metals, the following singular fact came under my observation.

Having dissolved a quantity of zinc (about a 30th or a 50th part) in a portion of mercury, I poured part of it into a tall glass-jar, and filled the remainder of it with a strong solution of muriatic acid and water. I then placed clear metallic wires perpendicularly in the jar, so that their extremities might dip into the amalgam; the moment they came in contact with it, hydrogen was evolved in great abundance from them. The mercury at the same time began to ascend on the wires, and continued to do so until it arrived as high as the liquid stood in the jar, and, when it attained this height, it ceased to rise any higher. And in whatever form the wire was bent, provided it was kept beneath the surface of the muriatic acid and water, the mercury followed it.

The mercury, in this instance, does not merely form a coating on the surface of the wire, but if sufficient time be allowed, it penetrates to its centre, and pervades every part of it, nor does there seem any limit to the height to which it will ascend, if the solution of the acid and water be present to favour the combination.

When a quantity of any of the fixed or volatile oils is poured over the surface of the muriatic acid and water, the combination ceases to go on through these liquids; nor will the mercury ascend higher than the level of the solution of acid.

In this action the zinc contained in the mercury becomes oxydated, and is dissolved and taken up by the liquid; and if sufficient time is allowed, it will be found on the surface of the wire, having a beautiful crystalline appearance; and when the action has ceased, the mercury will be left in its original pure state.

Wires of platina, gold, silver, copper, brass, tin, iron, zinc and steel, were subjected to this process, and the mercury rose upon all of them, but with very different degrees of rapidity.

A wire of platina, copper, iron and zinc, four inches in length, being placed into the amalgam, the mercury rose in the space of eight minutes to the top of the zinc-wire, in fourteen to the top of the copper-wire, and to the top of the platina and iron wire in about a minute longer. This rise, however, is not always uniform, but on the zinc wire it invariably rises most rapidly. By using a stronger solution of the acid and water, or by raising the temperature of the whole, the mercury rises more rapidly on the wires, and it apparently bears an exact proportion to the chemical action taking place on the surface of the metals. The cause of this singular action appears to depend upon the different and opposite electric states of the metals; the amalgam of the zinc and mercury being positive with respect to the wires; but whether it will account for the rapid rise on the zinc wire, which is in the same electric state, seems rather doubtful.

### 3. *Experiments on the Electro-Magnetic properties of Carbon when in a state of Combustion.*

The following experiments are intended to shew that carbon, when undergoing combustion, possesses the power of conducting the galvanic fluid of a single pair of plates, in the same manner as a continuous metallic wire,—of affecting the needle,—transmitting the metallic taste, and becoming magnetic.

I shall first describe the apparatus which I used, as it is simple, and well calculated for conducting electro-magnetic experiments. The general principles on which its action depends, I have explained in the last number of this Journal.

The present construction of the apparatus consists of a circular wooden box, A B, Plate V. fig. 1., four inches in diameter and one deep. From the opposite sides of the box, project two small glass-tubes C D, forming two cup-like cavities on the outside of it; only one of them C, opening into, and having a communication with, the inside of the box. About half an inch from the bottom, the diameter is lessened nearly a quarter of an inch, so as to form a projecting check round the inside of it, as seen in the plan of it, fig. 2. On this projecting check rests a circular plate of copper, perforated with holes, and having a wire of the same metal soldered to it.

In order to generate galvanism by this apparatus, a quantity of the liquid amalgam of zinc and mercury is to be poured into it, as much merely as to cover the bottom, and rise into the small tube, which communicates with the inside of the box. The copper-plate is then to be placed on the check, and over the whole is to be poured as much of a solution of muriatic acid and water, as will fill the space between the amalgam and the copper-plate, and rise a little above it. The extremity of the wire which is soldered to the copper-plate, is made to dip into the tube D, which has no communication with the inside of the box, and into which is also poured a small portion of mercury.

The apparatus being thus prepared, a communication is formed by wires passing from the two cup-like tubes. The one of these cups C, communicating with the amalgam, constitutes the positive plate; and the other D, being in connection with the copper, by means of the wire which dips into it, forms the negative plate.

*Experiment* I.—The apparatus being charged, a wire was inserted into each of the cups, whose other extremities were so connected by mercury, with a needle apparatus, as to form a continuous wire passing below the magnetized needle, which was delicately suspended by a single fibre of silk, and enclosed in glass to prevent any currents acting on it.

The effect produced on it was sufficient nearly to make it stand at right angles to its natural position.

*Experiment* II.—In this experiment the electricity was made to pass through the space of six inches filled with burning coke, having no metallic communication.

Having attached to the ends of two copper wires, a rod of iron, about a quarter of an inch in diameter, one end being beat out, so as to present a greater surface to the action of the furnace, and the other ends attached to the copper wire being amalgamated, to form a more perfect contact, they were both placed at the distance of six inches from each other, into a brick furnace, filled with burning coke, and in which there was no metallic grating.

When the temperature of the furnace was at a dull red heat, and the circuit completed, part of which circuit was formed by the coke, the needle was very slightly affected, showing that the electricity passed through the six inches of burning coke with some difficulty. When the temperature was raised to a *bright red* heat, the effect produced on the needle was much more apparent. When it had arrived at the melting point of copper, the effect was about double that of the preceding, and it went on increasing as the temperature was augmented, till it attained the melting point of iron, when the effect was not much inferior to that produced by a complete metallic communication.

*Experiment* III.—A solid cylindrical piece of charcoal (Plate V. Fig. 3.) about an inch in diameter, and six inches in length, being prepared, it was made to form part of the galvanic circuit, by having copper wires coiled round each end of it, for the space of about an inch and a half, leaving the middle part of it without any metallic communication.

On the communication being formed with the needle apparatus, no effect whatever was produced on the needle, showing that charcoal, at a natural temperature, is not capable of conducting the electricity of a single pair of plates, so as to affect the needle.

The cylinder of charcoal was then lowered into the furnace, which was at a high temperature.

When it had arrived at a red heat, the needle indicated, by its deviation, that the electric current was circulating, and as the temperature of the charcoal increased, the deviation became gradually greater. The piece of charcoal was afterwards raised, till it was brought opposite to the flue of the furnace, into which a strong current of air was passing. Here the charcoal underwent a rapid combustion, and the effect produced on the needle was much increased.

*Experiment* IV.—Having prepared a cylindrical piece of charcoal (Plate V. Fig. 4.), and coiled round each end of it copper wires, it was placed into a glass tube, A B, of a little larger diameter than itself, to admit of the wire expanding. The ends of the tube were then hermetically sealed round the wires. The communication being made, as formerly, the tube was gradually lowered into the furnace, and, when it arrived at a red heat, no effect whatever was produced on the needle. When the furnace had arrived at a high temperature, and the glass had fused around the charcoal, a very slight effect was perceptible on the needle; but it did not seem nearly so great as that produced when the charcoal was in a state of combustion—the temperature in both cases being alike.

It would appear from these experiments, that the conducting power of charcoal depends more upon its undergoing combustion, than upon the temperature to which it is raised.

The following experiments were performed, to ascertain whether or not charcoal, when forming the galvanic circuit, becomes magnetic, like metallic wires, or merely acts the part of a conductor, without displaying the phenomena of attraction and repulsion.

The apparatus used in this case consisted of a glass jar, A B, (Fig. 5.) into the bottom of which was placed a magnetic needle, C. It was provided with a wooden cover (Fig. 6.), made to fit it tightly, having a narrow longitudinal opening cut in it, *e f*. At each end of the opening, two small cavities, *g g*, were also formed. Fig. 6. represents the surface of the cover.

A wire from each end of the galvanic apparatus already described, was made to terminate in each of the small cavities, *g g*, into which a small portion of mercury had previously been poured.

A cylindrical piece of charcoal, a quarter of an inch in diameter, and six inches in length, being prepared from beech, and well washed, a copper wire was coiled round each end of it, leaving a space of four inches in the middle, without any metallic communication. The wires were so formed, as that their extremities might dip into the small cavities, *g g*, to complete the circuit, as seen in Fig. 5.

The jar being now filled with oxygen gas, the needle was placed on the pivot, and allowed to take its natural direction. The longitudinal opening *e f*, was also closed by a piece of wood fitted into it, and removable at pleasure.

Experiment.—The piece of charcoal having been heated to redness in the flame of the blowpipe, was immediately passed into the jar, through the longitudinal opening *e f*, (the piece of wood being removed and again replaced), and made to descend, until it was about a quarter of an inch above the needle, and parallel to it. The other extremities of the wires were turned, so as to terminate in the cavities *g g*.

The circuit being completed by means of wires brought from the former apparatus, and terminated in the cavities *g g*, the needle immediately deviated from its natural position, which proved that the electricity not only passed along the charcoal, but that the charcoal also became magnetic, like metallic wires of the same thickness, when conducting galvanic electricity.

From the small apparatus which was used for exciting the galvanic energy in this experiment, and the consequent diffuseness with which the electricity passed over the charcoal, it being necessarily thicker than a metallic wire, to prevent it being broken, the effect produced on the needle was not very powerful. If a large apparatus were used, such as that belonging to the London Institution, experiments of an extremely interesting nature might be performed; as, for instance, to ascertain whether or not the passage of a very large quantity of electricity accelerates or retards the combustion of the charcoal; or, whether the electricity may not altogether deprive the charcoal of its affinity for oxygen.

Experiment.—Having prepared a cylindrical piece of charcoal C (Fig. 7.), an eighth of an inch in diameter, and inserted its extremities into two cups A, B, which contained mercury, so as to be in perfect contact with the mercury, three galvanic troughs, each of sixty plates, four inches square, were charged with a weak solution of muriatic acid and water. They were placed parallel to each other, and their similar poles connected, so as to form one battery, equivalent to one of sixty plates, seven inches square. The circuit was completed by a copper wire, of the same thickness as the charcoal to be afterwards used. The wire affected the needle, when brought over it at a distance of seven inches, very powerfully. The wire was now cut through its centre, and its cut extremities placed into each of the cups of mercury, so as to form through the charcoal the galvanic circuit. The needle, suspended by means of a fine fibre of silk, was then brought above the charcoal as closely as possible, but without coming in contact with it, yet not the slightest effect was produced on it.

Experiment.—The same troughs, without any more acid being added, were now arranged, so as to form one battery of 180 plates, four inches square, and the circuit completed by a wire brought over the needle. The effect upon it, of course, was much less than with the former arrangement. The wire was then cut, as formerly, and its extremities brought into contact with the mercury in the cups, so as to form the galvanic current through the charcoal. The needle used in last experiment was now brought over the charcoal, and it was immediately affected.

As long as the circuit remained complete, a deviation of eight or ten degrees only took place; but when the circuit was alternately broken and completed, by taking out and again dipping the wire into the cup of mercury, and watching the instant when the needle attained its maximum of deviation at the time, it was made to stand almost at right angles to its natural position.

# *General Considerations on the Nature of the Vegetation which covered the Surface of the Earth, at the Different Epochs of the Formation of its Crust: Agreement of Antediluvian Botany and Zoology; and Conjectures relative to the Aspect of the Earth, and the Temperature of its Atmosphere, during these Different Epochs.* By M. ADOLPHE BRONGNIART *.

THE ardour with which naturalists have engaged since the commencement of the present century, in collecting materials for the physical history of the formation of the crust of the globe, brings us every day nearer to the period when we shall be able to trace with precision the history of the various strata that have been successively deposited at its surface, and of the animals and vegetables which have lived, whether in the seas that covered it, or upon the dry parts of this surface.

We have not yet, however, attained this object, towards which ought to be directed all the efforts of the geologists and naturalists, who, by their researches, labour to throw light upon the history of the organised beings of the primitive world; but it is useful from time to time to exhibit a picture of the state of science, to show the solid results which have been attained, to point out the doubts which remain to be solved, or the voids which it may be hoped to fill up. By this means, a more useful direction may be given to our inquiries, by fixing as it were the points around which the new discoveries may be arranged. This is the object which I have in view in the present memoir, with respect to the history of fossil vegetables, considered with reference to the relations that exist between the periods during which they have lived, and the botanical characters which they have presented.

Perhaps no department of natural history has made more rapid advances within these ten years, and our acquirements on this subject are very different from what they were in 1822, when I submitted to the Academy the results of an investigation on which it notwithstanding condescended to bestow the most flattering approbation. Since that time, the examination of the fossil vegetables of the different strata of the globe has engaged the attention of the geologists of France, England, Germany and Italy, and remarkable specimens of these fossils have been collected in America, in India, and even in New Holland. The discoveries made in some of these countries have been made known to us by various works; but the results to which I am desirous of drawing the attention of the Academy for a few moments, are in a great measure founded upon the yet unpublished matters which I have collected on my travels, or which have been transmitted to me by the naturalists of the countries which I have just mentioned, with a liberality for which I cannot too strongly express my gratitude.

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* We have great pleasure in presenting this important memoir of our young friend Brongniart to the attention of naturalists. The views it contains are similar to those we have been in the practice of delivering to our pupils in the University, both in the class-room and during our geological excursions.—EDIT.

We do not yet, however, possess sufficient information respecting the geology and organic remains of the other parts of the world, to be able to form any decided opinions with respect to them. Our results are all based upon the examination of the fossils of Europe and North America, and although from what we already know, it is very probable that they will apply to the other regions, we yet cannot make any positive affirmations on this subject.

The number of the species of fossil plants known, whether through the works which contain descriptions and figures sufficiently accurate to enable us to determine them with some degree of certainty, or through the specimens preserved in the collections which I have visited, or in my own private collections amount to 500 or 550.

These species are very unequally distributed in the strata of different antiquity, which constitute the crust of our planet; and this inequality in the distribution of the fossil plants, which is already remarkable, when we consider the total number of species contained in each stratum, becomes still more striking when we compare the numbers belonging to the different classes of each of these floras.

These latter results necessarily require an exact determination of the species, or genus, or family, or at least of the class to which each fossil plant belongs. We should be transgressing the limits which we have traced for ourselves, were we to establish here the degree of precision of each of the determinations at which we have arrived. This investigation, founded upon numerous and minute comparisons of organs, and of their structure, being entirely a work of detail, cannot be exhibited in all its particulars. I have pointed out the course which I have followed in this investigation, in the first two numbers of my work on Fossil Vegetables.

I would only remark, that, in most cases, the great class to which these fossils belong may be determined with certainty, and that often the family, and sometimes even the genus from which they come, may be made out.

By the great classes, I here mean the first very natural divisions that may be established in the vegetable kingdom. These divisions may, I think, be carried to six; the *Agamic plants;* the *Cellular Cryptogamic;* the *Vascular Cryptogamic;* the *Gymnospermous Phanerogamic*, comprehending under this name the Coniferæ and the Cycadeæ; the *Monocotyledonous Phanerogamic;* and the *Dicotyledonous Phanerogamic.*

I imagine that every person who will attentively examine this division, will agree with me, in the *first* place, that these classes are very natural; and, in the *second*, that it is almost always possible, by means of any well preserved organ, to discover to which of these six classes a fossil plant has belonged.

It was necessary for me to explain these bases of the botanical division which I have adopted; for it is from the comparison of the number of vegetables of these classes, at the different epochs of formation of the crust of the globe, that the most remarkable differences of its vegetation result.

It is generally known, that according to the researches of geologists, the deepest part of the crust of the earth appears formed of rocks, for the most part crystalline, in which no remains of organised beings are met with; that upon these rocks have been successively deposited strata of a different nature, the greater part formed by sediment; and that in these strata, whose relative position equally indicates the relative period of formation, there have most commonly been found more or less abundant remains of animals and vegetables. Several of these strata presenting common characters, which seem to indicate a similar origin or mode of formation, the name of *formation* has been given to their aggregate, and to several of these formations united by other more general characters, the name of *series of formations (terrains)*.

Many geologists admit four of these great series of formations posterior to the existence of organised beings, the *transition* formations intermediate between the primitive formations, and the true sedimentary formations, and the *inferior*, *middle*, and *superior sedimentary* formations.

The consideration of fossil vegetables has not hitherto contributed in any degree to the elaboration of this geological classification, which will serve as a basis for comparing the vegetables which grew at the earth's surface at the epochs when the formations were deposited.

If we commence with grouping together all the vegetables which belong to the same formation, we shall see that the plants which occur in the different beds of the same formation differ very little from each other, as might be expected; but we shall see, moreover, that there often exist great relations between the fossil vegetables of several successive formations.

These relations between the plants of allied formations will not, however, be founded in all cases, upon the identity of the species, nor even sometimes of the genera, but upon the numerical relations of the great classes of the vegetable kingdom.

The successive distribution of vegetables over the surface of the globe, during the different epochs of its formation, may in many respects be compared with the geographical distribution of vegetables over the present surface of the earth.

In the same manner as the surface of the globe is divided into regions, in which the same kind of vegetation exists, may also, the long period of time, be divided during which the crust of the globe was formed, in epochs of greater or less extent, during which the vegetation presented common characters.

The regions in botanical geography sometimes differ not only through changes which take place in the species of plants which constitute the flora of each of these regions, but also through modifications in the proportions of the different classes of the vegetable kingdom. In like manner, in the floras peculiar to the different epochs of the earth's formation, the differences are sometimes limited to changes of species of the same genus, or of genera of the same family, which take place of each other, without perceptibly altering the mutual relations of the different classes of vegetables to each other. At other times, on the contrary, on comparing the fossil plants of two formations, of which the one follows the other, there are not only observed specific or generic changes, but certain families entirely disappear, and their number is so changed, with relation to that of the other families, that the proportion of the great classes of the vegetable kingdom is completely modified.

In thus considering the floras of each geological formation, we find that they may be united, by common characters, deduced from considerable differences in the numerical relations of the classes, and from the absolute diversity in the species and genera, into four great groups or periods. During each of these periods, the vegetation has only presented gradual and unlimited changes, which have not influenced the essential characters of the vegetation. From one period to that following it, there is, on the contrary, an abrupt transition, a sudden difference in the most important characters of the vegetation.

The comparison of the characters of the vegetation of these four periods, is the principal object of this memoir.

But, before examining their characters, we must first determine their limits. *The first appears to extend from the first transition deposits to the end of the coal formation. The old red sandstone of Werner, and magnesian limestone, form its upper limit.*

*The second corresponds to the epoch of formation of the variegated sandstone.*

*The third commences at the shell-limestone deposit, or rather at the sandstone named keuper, which immediately covers it, and extends to the chalk.*

*The fourth comprehends all the deposits lying above the chalk, and which are commonly designated by the name of tertiary formations.*

A rather curious result of this division, to which we have been led by considerations entirely independent of geology, is, that it corresponds almost precisely with the four great groups of formations adopted by geologists.

*The first period in fact corresponds to the Transition formations, among which some geologists include the Coal formation.*

*The second comprehends the greater part of the inferior sedimentary formations.*

*The third embraces the end of these formations, and the middle sedimentary formations.*

*The fourth corresponds exactly to the Tertiary or upper sedimentary formations.*

It ought also to be observed, that the limits of these periods appear connected in a particular manner with the geological phenomena which have given rise to the strata of the globe. In fact, the strata which contain the remains of vegetables, which we consider as belonging to the same period, are almost always separated from those which belong to another period of vegetation, by formations which seem entirely destitute of land vegetables, and whose epoch of formation corresponds to a period of time during which the earth was perhaps completely covered by the sea, or almost entirely destitute of terrestrial vegetables.

Thus, the first period, or that of the coal deposit, is separated from the second, which corresponds to the variegated sandstone, by the old red sandstone, in which no vegetables have been observed, and by the magnesian or alpine limestone which has hitherto presented only marine vegetables.

The second period is separated from the third, which commences at the keuper and lias, by the shell-limestone or muschelkalk, which is also almost entirely destitute of fossil vegetables.

Between the third period, which ends with the upper beds of the Jura limestone, and the fourth, which corresponds to the upper sedimentary or tertiary formations, occurs the Chalk, in the mass of which no other vegetables have hitherto been found than a few marine plants.

This supposition of a complete or almost complete interruption of vegetation at the surface of the globe, between two of the periods of vegetation which we have admitted, is so much the more probable, that there exists no species common to two successive periods. Every thing is different in them, and the idea cannot be rejected, that a new vegetation, arising under influences different from those which previously existed, has occupied the place of the old vegetation.

The examination of the particular floras of each epoch of formation, having shewn us that we might group several of them together, and establish more extended periods, during which the earth appears to have possessed a vegetation, if not absolutely similar, at least analogous, it remains for us to compare the floras of these periods, and to examine what are the characters by which they are distinguished.

The tables appended to this memoir make known the vegetables hitherto found in the different formations belonging to the same period of vegetation. These vegetables are referred, with all the strictness which their state of preservation admits, to the genera, families and classes to which they have belonged; and we shall now make known the principal results elicited from their examination.

In the first period, which corresponds to the coal deposits, we see that of the six classes which we have admitted in the vegetable kingdom, only two existed. They are the vascular Cryptogamic plants, comprehending the Filices, Equisetaceæ, Lycopodia, &c., and the Monocotyledones, containing a small number of plants which appear to resemble the palms and arborescent liliaceæ *.

There remain, moreover, about twenty plants whose position is uncertain.

Thus, at the epoch in question, we find no *evident* trace of dicotyledonous plants, or Coniferæ or Cycadeæ. The class which has almost of itself composed this flora, is that of the vascular cryptogamic plants; and, in fact, of 260 species discovered in this *terrain*, 220 belong to that class.

But these vegetables, although evidently ranking in the families of Equisetaceæ, Filices, and Lycopodiaceæ, differ from the species, and frequently even from the genera at present existing in several points of their organisation, and especially in their gigantic size. All the researches which I have made for some years back, confirm the approximations which I have made between the Calamites and Equiseta, the Sigillariæ and the stems of the tree Ferns, the Lepidodendra and the Lycopodiaceæ;

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* In the present memoir we pass over the marine plants, which belong to another order of vegetation, and speak exclusively of those which grew on the uncovered parts of the earth's surface.

and all the naturalists, who have paid attention to the subject, appear now to adopt this opinion.

There existed, at this epoch, Equiseta upwards of ten feet high, and from five to six inches in diameter; tree Ferns of from forty to fifty feet in height; and arborescent Lycopodiaceæ, of from sixty to seventy feet high.

The essential characters of this first vegetation of the globe are, therefore, the numerical predominance of vascular cryptogamic plants, and the great development of these vegetables.

The second period of vegetation, which comprehends the plants whose remains have been enveloped in the variegated sandstone, is yet very little known. The terrestrial plants, to the number of twenty, which have been found in this deposit, differ totally from those of the older or newer formations, and evidently indicate a particular vegetation peculiar to this epoch. The numerical relations of the different classes are also very different, in as far as can be determined with so small a number of species. Thus the cryptogamic plants are less numerous, and appear of smaller size. They do not form the half of the Flora. Four or five plants belong to a particular genus of the family of Coniferæ; but no plant of the family of Cycadeæ, appears to exist at this epoch. Lastly, some monocotyledonous plants of singular appearance, but difficult to be approximated to living species, complete the flora.

We see that of the four classes of vegetables which we particularly consider, making abstraction of the agamic and cellular cryptogamic plants, three make their appearance at this epoch, in place of only two which existed in the preceding period. The dicotyledones are still wanting.

The flora of the third period of vegetation is much better known. Seventy species have been discovered in the formations included between the shell limestone and the chalk. These species are totally different from those of the older formations, and give to the vegetation of this epoch very peculiar characters, depending upon the nature of these plants, and their numerical relations to each other.

These seventy plants still belong only to three of the great classes of the vegetable kingdom. These classes are the same, it is true, as those of the preceding period; but the species, genera, and even the families, are different. Thus, the Cycadeæ appear, for the first time, at this epoch, and continue, with some modifications in their forms, until the end of this period, of which they constitute the essential character. This family, and that of the Coniferæ, which we consider as composing together a particular class, did not then, as now, form scarcely a hundredth part of the existing vegetables, but, on the contrary, composed of themselves alone the half of the flora of this period of vegetation, and of the thirty-five species of this class that have hitherto been observed in these formations, twenty-nine are Cycadeæ. This family, therefore, was more numerous at an epoch, when the flora of the earth appears so poor, and so little diversified, compared with its present state, when more than fifty thousand living plants are known.

The rest of the flora of this third period of vegetation is almost entirely formed by the vascular cryptogamic plants, such as the Ferns, the Equisetaceæ, and the Lycopodiaceæ. Thus, the essential character of the vegetation of this period, consists in the great numerical predominance of the Cycadeæ, and in the nearly equal division of all the vegetables into two classes, that of the vascular cryptogamic plants, and that of the gymnospermous phanerogamic plants.

There exist but very rare indications of Monocotyledones, and nothing yet announces the existence of Dicotyledones.

The presence of dicotyledonous vegetables, and the numerical predominance which they acquire over the other vegetables, the moment they make their appearance, characterize the fourth period of vegetation, that which corresponds to the formations analogous to those of the Paris basin, and which are designated by the names of Upper Sedimentary, or Tertiary Formations.

At this epoch, the proportion of the different classes of plants appears to have been nearly the same as upon the present surface of our globe. The Dicotyledones are at least four or five times more numerous than the Monocotyledones. As to the other classes, the peculiar circumstances in which these deposits have been formed, appear to have diminished their number. There are only found some traces of Ferns, Equiseta, and Mosses, and the agamic plants are only represented by various species of marine vegetables. The plants of this period generally appear to belong to genera still existing; and the specific differences, although almost always perceptible when the fossil plants are carefully compared with the living species of the same genera, are often very slight.

From the manner in which we have defined what we name a period of vegetation, it may therefore be said that the vegetation which covered the earth, during the deposition of the tertiary formations, and that which at present grows upon its surface, belong to the same period.

It will be seen that the manner in which we have above considered the essential characters of the vegetation, at the different epochs of formation of the earth's crust, is almost entirely removed from the influence of the errors of detail, which it is impossible to avoid in a science still in its infancy. Should more precise observations or new discoveries make known in the old formations some plants of more than one of the classes which we have admitted, or even some species of one of the classes which have appeared to us to be wanting at this epoch, still the essential relations of these classes to each other would be but slightly modified. Thus, it might be proved that certain yet little known genera of the coal formation are true dicotyledonous plants; yet it would not be the less certain that the vascular cryptogamic plants, were by much the most numerous vegetables during the first period of vegetation. Some leaves of really dicotyledonous plants might be discovered in the Lias, or Jura limestone; yet these species being necessarily very rare, would not change the essential relations between the number of species belonging to the other classes, and the gymnospermous phanerogamic plants; the Cycadeæ, in particular, would not the less be the characteristic plants of this epoch. Thus, whatever further discoveries may be made, it may be established with all the certainty which the sciences of observation present, that the essential characters of the four periods which we have above indicated, can be but slightly modified, and that these periods themselves will always remain perfectly distinct.

The vast numerical predominance of the vascular cryptogamic plants, that is to say, of the Filices, Equisetaceæ, and Lycopodiaceæ, and the great development of these plants are the essential characters of the first period.

The numerical equality of the vascular cryptogamic plants, the gymnospermous phanerogamic plants, represented by the Coniferæ, and the Monocotyledones, together with the less development of the vegetables of the first of these classes, appear to be the essential characters of the second period.

The third period is peculiarly distinguished by the predominance of the gymnospermous phanerogamic plants, and especially of the Cycadeæ. The vascular cryptogamic plants hold the next rank, and after them come some Monocotyledones in very small number.

Lastly, the fourth period presents vegetables of all the classes at present existing, among which, as at the present epoch, the Dicotyledones are by much the most numerous. Then come the Monocotyledones, the Gymnospermous Phanerogamic plants; and, lastly, the Cryptogamic and Agamic.

We therefore see that the terrestrial vegetation has always been rendered more and more varied; that, from being at first limited to two principal classes, it presents three at a later period, and at length five, and that in the vegetable kingdom as in the animal kingdom, the beings which every thing leads us to consider as the most simple, were the first formed, and the classes of more complicated beings, which, for that reason, we call more perfect, have been gradually added to these first classes of more simple original beings.

Such are the positive results, independent of all hypothesis and all preconceived theory, to which the comparative examination of fossil vegetables conducts us.

But, as by putting into the hands of a botanist a herbarium formed in a distant region of the earth, he would easily determine the nature of the climate under whose influence these vegetables grew, might we not, from the nature of the floras of these different periods of formation of the terrestrial surface, be enabled to determine some of the circumstances which presided at the development of these vegetables?

I am of opinion that, by attentively comparing the nature of the vegetables of these different epochs with those which at present grow in the different regions of the globe, we may arrive at results, if not certain, at least very probable, in respect to this subject.

Let us first compare, with this object, the flora of the first vegetation, that whose remains have produced the coal-beds; those great deposits of combustibles, whose utility has made them to be sought out and explored in almost all countries, and whose disposition and fossil vegetables are for this reason much better known than those of any other epoch. The remarks which the examination of this flora supply, are only as yet founded upon the fossils collected in Europe and North America; but the few fossils of the same epoch collected in the other parts of the world, appear to agree with those of our own countries in leading to the same consequences.

It had long been observed that the vegetables of this formation generally approach nearer to those of the warmest parts of the globe, than to those of the temperate regions; but now that the fossil plants of this epoch are much better known, and that their resemblance to the existing vegetables has been founded upon a more strict examination, their relations to the plants of the equatorial regions may be established on more solid bases.

All the plants of the class of vascular cryptogamic vegetables, to which belong most of the vegetables of this epoch, acquire a development proportionate to the heat of the climate in which they grow; or, rather, in cold climates, there are only found small species among the plants of this class, while in the tropical regions there occur, together with small species, numerous species of a much greater size. Thus, the Ferns of the cold or temperate climates all creep on the ground, or their stem has only a height of a few inches; those of the equatorial regions often attain a height of ten, fifteen, and twenty feet; the smallest species of Equiseta known are those of Lapland and Canada; the largest grow in the West Indies and equinoctial America; the Lycopodia of our regions never rise higher than five or six inches; those which grow between the tropics often attain three or four times that height.

The still greater size of the Ferns, Lycopodiaceæ and Equisetaceæ buried in the coal formation, therefore authorises us to presume that during this period, all the circumstances calculated to favour the development of these plants, had acquired their highest degree. Heat and moisture are the principal, and it is difficult not to admit, that at this period the temperature of the earth's surface was equal, and perhaps superior, to that of the warmest parts of our globe. This inference, moreover, is in perfect accordance with the opinions of most of our present geologists, and with the observations and theories of the most celebrated natural philosophers and mathematicians.

The second remarkable character of the flora of this period consists in the numerical relation of the plants of the different classes, and which is such that the vascular cryptogamia, which at the present epoch form at the most one-tenth of the plants known, then constituted more than nine-tenths of the vegetation.

There does not, therefore, exist the smallest relation between the primitive flora of our globe and the mass of its present vegetation. But are there not some parts of the globe, some particular regions, which, without presenting exactly the same proportions between the different classes of the vegetable kingdom, at least approach in this respect to the ancient flora?

This, in fact, is what the study of the distribution of vegetable forms over the surface of the globe demonstrates to us. The family of Ferns, and the allied families, according to the observations of Mr R. Brown and M. d'Urville, appear to be subjected to the influence of two principal causes, which determine their mode of distribution.

Of these two causes, one is the elevation of the temperature; the other appears to be the influence of the humid air, and uniform temperature of the sea.

There results from these causes, that, in the localities equally favoured by them, these plants are more frequent in the equatorial zone than in the colder zones; but that, in the same zone, they are much more abundant in the islands than upon the continents. We might adduce numerous examples in support of this proposition, but this would lead us too far from the particular subject of the memoir, and we shall only say, that, in the parts most favourable to the development of these plants on the continent of temperate Europe, the proportion which they bear to the Phanerogamous plants is as one to forty, while, in the same circumstances, in the continental regions between the tropics, Mr R. Brown admits that this proportion is as one to twenty, and, in the least favourable cases, as one to twenty-six.

Under the same latitude, this proportion becomes much greater in the islands. Thus, in the West Indies the proportion of Ferns to the Phanerogamic plants appears to be nearly as one to ten, in place of one to twenty, which is that of the most favourable parts of the American continent. In the South Sea Islands, this proportion, in place of being as one to twenty-six, as in the continent of India, and the tropical parts of New Holland, becomes as one to four, or as one to three. At St Helena and Tristan d'Acuna, the proportion of these classes of vegetables is as two to three. Lastly, in the Island of Ascension, considering only the plants evidently indigenous, there appears to be an equality between the Phanerogamic and the vascular Cryptogamic plants. It is seen from these examples, that the smaller the islands are, and the more remote from the continents, the greater does the proportion become which the Ferns, and allied families, bear to the total number of the other vegetables; and it may be conceived, that, were islands, like those just mentioned, alone to exist in the midst of a vast sea, where they would only form scattered points, or small archipelagoes, without any great continent, the proportion of Ferns would probably be still greater; and, in place of an equality in the two great classes of vegetables which we compare, we might see the vascular Cryptogamic plants greatly predominating over the Phanerogamic. This is what took place at the epoch of the formation of the coal deposits, and these considerations of botanical geography should of themselves incline us to think that the vegetables which gave rise to these deposits grew upon archipelagoes of islands of small extent, at an epoch when no great continent rose above the surface of the waters.

The disposition of the coal deposits in interrupted lines, which have been called basins, and, compared with lake successions or valleys, has at least a considerable analogy to the disposition of the islands which, representing the ridges of submarine mountain-chains, are generally placed in rows. Lastly, the interruptions of the coal formation, and, on the contrary, the great extent and continuity over large spaces of the transition limestone formations, which may be considered as the deposits formed in the sea which surrounded these islands, seem to confirm this hypothesis.

Count Sternberg and M. Boué, proceeding solely on geological considerations, have equally been led to admit that, at the epoch when the coal formations were deposited, the continents must have had less extent, and the seas must have covered a greater surface than now. The considerations of primeval botanical geography which we have above detailed, seem to us to give much more probability to this supposition.

Geology and botany, therefore, appear to us to agree in announcing that, at this epoch, the parts of the earth which rose above the waters formed only islands of small extent, disposed in archipelagoes in the midst of vast seas.

It was on these islands that the plants grew whose remains have given rise to the coal beds, and of which we still find some untouched remains in the rocks which accompany these beds of combustible matter. As to the manner in which these beds themselves were formed, it belongs, for many reasons, more to geology than to the botany of the ancient world. I cannot, however, avoid saying a few words with respect to it, for, in some respects, this phenomenon is probably connected with the manner in which these vegetables grew at the surface of the soil.

Geologists have formed very different ideas respecting the origin of this combustible; and, to speak only of those who attribute it to the vegetables which then grew upon the earth, the only opinion which appears to us to be now admissible, some have considered the beds of coal as a kind of peat deposites of greater or less extent, formed by the remains of vegetables, and on which other vegetables still grew, while others have regarded these beds as formed by a sediment of decomposed vegetable matters, at first held in suspension in the water of the sea, and afterwards deposited at the bottom of that fluid.

The former of these hypotheses, which has for its author the celebrated Deluc, appears to me to accord better with the general disposition of the coal deposites, and several of the remarkable circumstances which they present, such as the pretty frequent existence of trunks of trees still placed perpendicularly to the strata in the direction which they must have occupied during life. The other hypothesis, which has in these latter times been supported by MM. Sternberg, Boué, and Constant Prevost, perhaps, more easily explains the alternations of beds of coal and other sedimentary rocks, but seems to me incompatible with many circumstances which the coal deposites present.

It may be objected to the first hypothesis, which appears to us the most probable, that we now no longer see peat formations entirely, or almost entirely, composed of Ferns and similar plants; but the circumstances under whose influence these vegetables grew were very different from those which now exist, and it is probable that many of these circumstances were calculated to facilitate the formation of such peat formations. Besides, it is perfectly well known that many plants of these families grow abundantly in localities of this kind; the Equiseta, for example, Osmunda regalis, several Aspidia and Lycopodia, grow habitually in our peat soils. Lastly, we have scarcely a doubt that, at this remote epoch, our atmosphere had a very different composition from what it has now, and that this difference exerted a powerful influence upon the formation of those beds of vegetable combustible. We shall revert to this subject.

Let us now take a review of what we have just said respecting the nature of the vegetation of our globe at this epoch, and the data which it supplies, with reference to its physical constitution. We see that the vegetable kingdom, composed almost entirely of gigantic vascular cryptogamic plants, indicates the existence, at this epoch, of a temperature much higher than that of our climates, and perhaps superior to that of the warmest regions of the earth; that this same vegetable nature seems to prove, that our globe was almost entirely covered by the sea, from the bosom of which there rose some islands, whose vegetables, after their death, formed beds of a kind of peat, which afterwards slipping into the sea, as Deluc imagined, or covered by circumstances which it does not form part of our object to examine, by beds of rocks of various kinds, gave rise to the coal deposits.

We have not nearly so many data with respect to the vegetation of the subsequent periods. Thus, the remains of vegetables discovered in the variegated sandstone are too few in number, to allow us to draw any inference from them, as to the state of the globe at that epoch. We can only infer, from the presence of an arborescent fern in this formation, that the temperature was at that period still much higher than that of our climates, and was probably similar to that of the intertropical regions.

In the third period, the vegetation assumed a more peculiar character. The cycadeæ, together with the ferns and some coniferæ, almost entirely composed it. This vegetation, although different from that of any part of our globe, yet comes nearer to that of the coasts and large islands of the equatorial zone, for the cycadeæ grow chiefly in the West India Islands, on the coasts of Brazil, at the Cape of Good Hope, in the Moluccas and Japan, and on the coasts of New Holland. They are, consequently, plants of warm climates placed near the tropics, and countries subjected to the influence of the sea air and temperature. The ferns, as we have already said, are still more peculiarly of this character. It might therefore be concluded from these facts, that the vegetation of the epoch in question must have grown upon islands of small extent; but I do not pretend to attach a very great importance to this conclusion, the botany of this period being as yet very imperfectly known. The only consideration to which I attach some probability is, that the flora which leads us to this result, corresponds to an epoch intermediate between the insular flora of the first period, and the continental flora of the fourth.

The vegetation of the fourth period, in fact, presents all the characters of the vegetation of great continents and of temperate climates, or of climates a little warmer than those of the middle parts of Europe. It is generally similar to that of Europe and North America, and presents but a small number of vegetables like those of somewhat warmer regions, that is to say, some palms or other arborescent monocotyledonous plants. But, at this epoch, the local influences dependent upon slight differences of latitude, or of elevation or exposure, already appear to determine very sensible differences in the local floras, whose remains we find in different places. Thus, sometimes the mass of these vegetables seems to indicate a flora similar to that of the forests of the north of Europe or America; and sometimes, on the contrary, vegetables resembling those of warmer regions, not covered with woods, occur together in the same place.

The details, relative to the distribution of vegetables in the different beds and localities of the tertiary formations, remain yet to be discussed; but the aggregate of these vegetables presents a flora, in almost all respects similar to that of the present surface of the globe; and we can, with much probability, deduce from it, that the extent of the continents, the temperature and the nature of the atmosphere, differed but very little from what at present obtains. I am far from asserting, however, that things were then precisely as they are now; the results of geological and zoological investigation would entirely contradict such supposition. Thus, the continents were certainly of less extent than they now are, as the marine deposites of that epoch indicate that the sea covered them in part. The temperature was probably higher, for the nature of the animals of this same period indicates a warmer climate, but the general characters of the vegetation were the same. The same classes, in the same proportions—the same genera, and often closely allied species, existed at this epoch, and still exist. It may therefore be said that the vegetable kingdom was invested with the same forms as those which it now presents, and that it was subjected to a similar mode of distribution.

The study of the metamorphoses of the vegetable kingdom, if I may employ the expression, during the formation of the crust of the globe, seems therefore to announce, that the temperature and extent of the seas have always gone on diminishing, from the first appearance of vegetables upon the earth to the present epoch.

The comparison of the successive developements of vegetables and animals, is not one of the least remarkable parts of the study of these fossil organized bodies.

It is known, in fact, that, in the older deposites, or those of the same epoch as the coal formation, there exist no remains of land animals; while at that epoch the vegetation had already assumed a great developement, and was composed of plants, as remarkable for their forms as for their gigantic size.

At a more advanced period the terrestrial vegetation loses, in a great measure, this singular developement, and the cold-blooded vertebrate animals become very numerous. This state of things is what is observed during our third period.

Lastly, the vegetables become more diversified and more perfect, but those which resemble the plants that have first existed are reduced to a much smaller size. This is the epoch of the appearance of the most perfect animals, those which respire in air, the mammifera and birds.

Might not some cause be found which would explain, in a natural manner, this developement and vigorous vegetation of the terrestrial plants, at the most remote times of the formation of the globe, and, on the other hand, the appearance only in the later periods of its formation of the warm-blooded animals, or those whose aërial respiration is the most active? Might not this difference in the period of the appearance of these two classes of beings, depend upon the difference of their mode of respiration, and upon circumstances in the state of the atmosphere, calculated to favour the developement of the one kind, and oppose that of the other?

Under what form, at the period of the creation of organized beings, did all the carbon exist which these beings subsequently absorbed, and which occurs buried along with their remains in the bowels of the earth, or which still exists diffused among all the organised beings which at present cover the surface of the globe?

It is evident that animals not extracting carbon either from the atmosphere or from the soil, but only from their food, vegetables alone could have procured, in an inorganic substance, the carbon necessary for their growth, which carbon, through their intervention, afterwards served for the nutrition of animals.

We cannot conceive how, if this carbon had been in the solid state, the vegetables could have assimilated it; and besides, in the formations older than those which contain the first remains of vegetables, scarcely any traces of charcoal are seen.

It must therefore have been the case, that this carbon, which the plants of the primitive vegetation and of the subsequent vegetations absorbed, existed under a form calculated to afford them nutrition. Now, we only know two such forms, viz. vegetable mould, which, itself resulting from the decomposition of other vegetables, would lead us to reason in a circle; and carbonic acid, which, on being decomposed by the leaves of vegetables under the influence of the solar light, fixes its carbon in the plant, and thus contributes to its growth.

It therefore appears to me impossible to suppose that the vegetables imbibed from any other source than the atmosphere, or in any other form than that of carbonic acid, the carbon which is still found in all the vegetables and animals existing, and that after serving for their nutrition, has been deposited in the form of coal, lignite, or bitumen, in the different sedimentary deposites. If we then suppose that all this carbon, in the state of carbonic acid, was diffused in the atmosphere previous to the creation of the first organised beings, it will be seen that the atmosphere, instead of containing less than a thousandth part of carbonic acid, as is now the case, must have contained a quantity of it which cannot be exactly estimated, but which was, perhaps, 3, 4, 5, 6 or even 8 per cent.

The researches of M. Theodore de Saussure have shewn that this proportion of carbonic acid, so far from proving hurtful to vegetation, is very favourable to it, when the plants are exposed to the sun. This very probable difference in the nature of the atmosphere, may, therefore, be considered as one of the most powerful causes which have exerted their influence upon the very active and very remarkable vegetation of our first period.

But this very circumstance must, on the contrary, have been detrimental to the decomposition of the remains of dead vegetables, and have retarded their transformation into mould; for this mode of decomposition is essentially dependent upon the abstraction of a part of the carbon of the wood by the oxygen of the air; and if the atmosphere contained less oxygen and more carbonic acid, this decomposition must, without any doubt, have been more difficult and more slow. Hence the accumulation of those remains of vegetables in kinds of peat deposites, even under circumstances and with vegetables, which, in the present state of the atmosphere, would not give rise to the formation of similar beds of combustible.

On the other hand, this difference in the composition of the atmosphere, so favourable to the growth and preservation of vegetables, would have been an obstacle to the existence of animals, and especially to that of warm-blooded animals, whose more active respiration requires a purer air. Accordingly, during this first period, there does not appear to have existed a single animal that respired air.

During this period, the atmosphere was freed of a part of its excess of carbon, by the vegetables which grew upon the land, which assimilated it, and were afterwards buried in the state of coal in the bowels of the earth. It is after this epoch, during our second and third periods, that the immense variety of monstrous reptiles begin to appear, animals which, by their mode of respiration, are yet capable of living in a much less pure air than that which the warm-blooded animals require, and which, in fact, have preceded them at the earth's surface.

The vegetables continued to withdraw a part of the carbon from the air, and thus rendered our atmosphere daily more pure; but it was only after the appearance of a quite new vegetation, rich in large trees, and the origin of the numerous deposites of lignite, a vegetation which appears to have covered the surface of the earth with vast forests, that a great number of mammiferous animals, resembling, in the essential features of their organization, those which still exist upon the earth, for the first time made their appearance upon its surface. *

May it not be supposed that our atmosphere has, in this manner, arrived at the degree of purity which could alone suit the more active respiration of the warm-blooded animals, and equally favour the developement of vegetables and animals; while the simultaneous existence of these two orders of beings, and the reciprocating influence of their respiration, now keep our atmosphere in a state of stability, which is one of the remarkable characters of the present period.

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* In this general indication, I overlook the solitary exception resulting from the existence of the Stonesfield mammiferous animal in strata inferior to the chalk.

TABLE—*Shewing the Number of Species of each Genus and Family, peculiar to the Four Periods of Vegetation.*

| Names of the Classes, Families, and Genera. | 1st Period. | 2d Period. | 3d Period. | 4th Period. |
|---|---|---|---|---|
| **CLASS I.** | | | | |
| **Agamic Plants.** | | | | |
| *Confervæ.* | | | | |
| Confervites, | . . | . . | 2 | 1 |
| *Algæ.* | | | | |
| Fucoides, | 4 | 5 | 16 | 12 |
| **CLASS II.** | | | | |
| **Cellular Cryptogamic Plants.** | | | | |
| *Mosses.* | | | | |
| Muscites, | . . | . . | . . | 2 |
| **CLASS III.** | | | | |
| **Vascular Cryptogamic Plants.** | | | | |
| *Equisetaceæ.* | | | | |
| Equisetum, | 2 | . . | 2 | 1 |
| Calamites, | 14 | 3 | . . | . . |
| *Filices.* | | | | |
| Pachypteris, | . . | . . | 2 | . . |
| Sphenopteris, | 21 | 2 | 6 | . . |
| Cyclopteris, | 3 | . . | . . | . . |
| Neuropteris, | 12 | 2 | 1 | . . |
| Glossopteris, | 1 | . . | 1 | . . |
| Pecopteris, | 46 | . . | 12 | . . |
| Lonchopteris, | 2 | . . | 1 | . . |
| Odontopteris, | 5 | . . | . . | . . |
| Anomopteris, | . . | 1 | . . | . . |
| Tæniopteris, | . . | . . | 2 | 1 |
| Clathropteris, | . . | . . | 1 | . . |
| Schizopteris, | 1 | . . | . . | . . |
| Sigillaria, | 44 | . . | . . | . . |
| *Marsiliaceæ.* | | | | |
| Spheriophyllum, | 7 | . . | . . | . . |
| *Characeæ.* | | | | |
| Chara, | . . | . . | . . | 4 |
| *Lycopodiaceæ.* | | | | |
| Lycopodites, | 10 | . . | 3 | . . |
| Selaginites, | 2 | . . | . . | . . |
| Lepidodendron, | 30 | . . | . . | . . |
| Lepidophyllum, | 5 | . . | . . | . . |
| Lepidostrobus, | 4 | . . | . . | . . |
| Cardiocarpon, | 5 | . . | . . | . . |
| Stigmaria, | 8 | . . | . . | . . |
| **CLASS IV.** | | | | |
| **Gymnospermous Phanerogamous Plants.** | | | | |
| *Cycadeæ.* | | | | |
| Cycadites, | . . | . . | 1 | . . |
| Zamia, | . . | . . | 15 | . . |
| Pterophyllum, | . . | . . | 8 | . . |
| Nilsonia, | . . | . . | 2 | . . |
| Mantellia, | . . | . . | 3 | . . |
| *Coniferæ.* | | | | |
| Pinus, | . . | . . | . . | 9 |
| Taxites, | . . | . . | 1 | 5 |
| Voltzia, | . . | 4 | . . | . . |
| Juniperites, | . . | . . | . . | 3 |
| Cupressites, | . . | 1 | . . | . . |
| Thuya, | . . | . . | . . | 3 |
| Thuytes, | . . | . . | 4 | . . |
| Brachyphyllum, | . . | . . | 1 | . . |
| **CLASS V.** | | | | |
| **Monocotyledonous Phanerogamic Plants.** | | | | |
| *Nayades.* | | | | |
| Potamophyllites, | . . | . . | . . | 1 |
| Zosterites, | . . | . . | 5 | 2 |
| Caulinites, | . . | . . | . . | 1 |
| *Palmæ.* | | | | |
| Palmacites, | . . | . . | . . | 1 |
| Flabellaria, | 1 ? | . . | . . | 3 |
| Phœnicites, | . . | . . | . . | 1 |
| Zeugophyllites, | | | | |
| Cocos, | . . | . . | . . | 3 |
| *Liliaceæ.* | | | | |
| Bucklandia, | . . | . . | 1 | . . |
| Clathraria, | . . | . . | 1 | . . |
| Smilacites, | . . | . . | . . | 1 |
| Convallarites, | . . | 2 | . . | . . |
| Antholites, | . . | . . | . . | 1 |
| *Cannææ.* | | | | |
| Cannophyllites, | 1 | . . | . . | . . |
| *Monocotyledones of uncertain Family.* | | | | |
| Endogenites, | . . | . . | . . | several |
| Culmites, | . . | . . | . . | 3 |
| Sternbergia, | 3 | . . | . . | . . |
| Poacites, | 3 | . . | 1 | several |
| Palæoxyris, | . . | 1 | . . | . . |
| Echinostachys, | . . | 1 | . . | . . |
| Aethophyllum, | . . | 1 | . . | . . |
| Trigonocarpum, | 5 | . . | . . | . . |
| Amomocarpum, | . . | . . | . . | 1 |
| Musocarpum, | 2 | . . | . . | . . |
| Padanocarpum, | . . | . . | . . | 1 |
| **CLASS VI.** | | | | |
| **Dicotyledonous Phanerogamic Plants.** | | | | |
| *Amentaceæ.* | | | | |
| Carpinus, | . . | . . | . . | 1 |
| Betula, | . . | . . | . . | 1 |
| Comptonia, | . . | . . | . . | 2 |

## TABLE—*continued.*

| Names of the Classes, Families, and Genera. | 1st Period. | 2d Period. | 3d Period. | 4th Period. | Names of the Classes, Families, and Genera. | 1st Period. | 2d Period. | 3d Period. | 4th Period. |
|---|---|---|---|---|---|---|---|---|---|
| *Juglandeæ.* | | | | | Phyllites, . . . | . . | . . | . . | many |
| Juglans, . . . | . . | . . | . . | 3 | Antholithes, . . | . . | . . | . . | several |
| *Acerineæ.* | | | | | Carpolithes, . . | . . | . . | . . | many |
| Acer, . . . . . | . . | . . | . . | 1 | | | | | |
| *Nymphæaceæ.* | | | | | *Vegetables of uncertain Class.* | | | | |
| Nymphæa, . . | . . | . . | . . | 1 | | | | | |
| | | | | | Phyllotheca, . . | 1 | . . | . . | . . |
| *Dicotyledones of uncertain Family.* | | | | | Annularia, . . | 7 | . . | . . | . . |
| | | | | | Asterophyllites, | 11 | . . | . . | . . |
| Exogenites, . . | . . | . . | . . | Many | Volkmannia, . . | 3 | . . | . . | . . |

## TABLE—*Presenting the Number of Species of each Class during each Period.*

| | 1st Period. | 2d Period. | 3d Period. | 4th Period. | Present Epoch. |
|---|---|---|---|---|---|
| I. Agamic Plants, . . . . . . . . . | 4 | 5 | 18 | 13 | 7000 |
| II. Cellular Cryptogamic, . . . . . . | . . | . . | . . | 2 | 1500 |
| III. Vascular Cryptogamic, . . . . . . | 222 | 8 | 31 | 6 | 1700 |
| IV. Gymnospermous Phanerogamic, . | . . | 5 | 35 | 20 | 150 |
| V. Monocotyledonous Phanerogamic, . | 16 | 5 | 3 | 25 ? | 8000 |
| VI. Dicotyledonous Phanerogamic, . . | . . | . . | . . | 100 ? | 32,000 |
| Plants of undetermined species, . . | 22 | . . | . . | . . | . . . |
| Total of each Flora, . . . . . . | 264 | 23 | 87 | 166 | 50,350 |

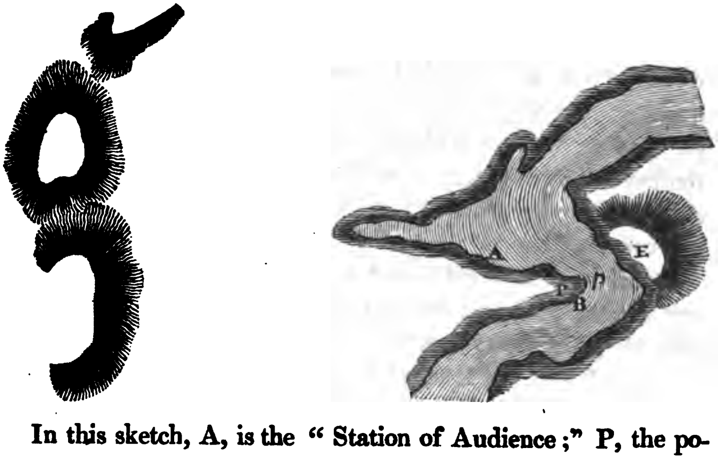
## *On the Remarkable Effect of Mountain Echoes, as developed by the Use of the Kent Bugle.* By the Reverend WILLIAM SCORESBY, F. R. S. L. & E. Member of the French Institute, &c. Communicated by the Author.

UNDER the excitement of the sublime appearances of mountain scenery, the sense of sight is not the only faculty which becomes the recipient of delightful impressions. The notes of the wild-fowl, the murmuring of the gentler streams, and the rushing sound of the impetuous cataract, contribute, by their respective intuitive associations, to the interest of the traveller. To these auxiliaries of enjoyment, amid the more splendid exhibitions of nature, the occasional echoes, with their various *diminuendo* of reverberation, afford a pleasing accession to the ordinary impressions of majestic scenery. And in respect to this particular, we have now a source of new and exquisite enjoyment, unknown to the admirers of nature in former days, through the introduction of the keyed bugle, for the developement of the echoes. From the application of the powerful and flexuous tones of this commanding instrument, for eliciting the echoes of mountain passes, and other situations favourable for reflecting sound, an accidental beauty has been discovered in the production of the most surprising harmonies from a series of simple tones. Though this effect, at the first hearing, so astonishing and apparently miraculous, has become familiar to most travellers who have visited the mountainous districts of the United Kingdom, yet it is worth consideration, on account of the curious and beautiful effect of the progression of sound, in producing a fortuitous coincidence, not easily to be imitated by the most elaborate combination of instruments.

The buglemen, who accompany parties of travellers through the rich, varied, and, in some particulars, unequalled scenery of the Lakes of Killarney, are particularly happy, though apparently ignorant of the principles on which they succeed, in the developement of the numerous echoes afforded by the cliffs and mountains around. In the Gap of Dunloe (the sublimely wild and celebrated pass between Tomie's Mountain and Macgilley-Cuddy's Reeks) the stations for musical echoes are various and interesting; but in front of the remarkable cliff called the "Eagle's Nest," which is washed by the river communicating between the Upper and Lower Lakes of Killarney, the repercussion of sound is of the most striking and extraordinary perfection I have any where heard. The manner in which it is elicited is twofold; by the use of the paterera, and of the bugle. The place selected for witnessing the results has been determined by innumerable experiments; and to any one acquainted with the principles of acoustics, it is at once evident, that it affords an extraordinary combination of favourable circumstances for producing the realised effects. The Eagle's Nest, from its peculiar form, and vertical position, is admirably calculated for the repercussion of sound; the smooth and sheltered surface of the intervening water for conducting the reverberations; the positions, on the opposite shore, chosen by the gunner and bugleman, for giving the primary sound; and the place of the "Station of Audience," for obtaining the most happy combinations of the direct sound and the echoes.

The surface from whence the principal echoes are derived, is a rock of a pyramidal form, rising almost perpendicularly from the verge of the stream, to the height of 1200 to 1300 feet. The base is covered with wood, which, from its general evenness of surface, quietness of repose, and elasticity of foliage, may possibly reflect and modulate, instead of absorbing, the impression received from the air by the action of the gun and the bugle. There is likewise, if I mistake not, a slight depression or concavity in the surface of the rock, immediately above the thickest of the wood, by which a concentration of the returning sound may probably be produced. Such is the source of the principal echoes.

The annexed eye-draught of the relative position of the different arrangements, may assist in the explanation and description of the phenomena.



In this sketch, A, is the "Station of Audience;" P, the position of the ordnance; B, the station of the bugleman; and E, the chief reflecting surfaces of the Eagle's Nest.

When the paterera is fired, the echoes being given from a variety of surfaces on the Eagle's Nest, and more remotely from the distant faces of the majestic mountains, the "Mangerton" and the "Turk," produce not only a return of the sound of the explosion with startling violence, but a protracted reverberation, continuing for the space of nearly thirty seconds, so as to be usually compared, and that without extravagance, to "a peal of thunder, or the discharge of a train of artillery." But the result of this experiment, which is more astonishing than pleasing, is too common in mountainous countries, to justify any more particular description. Not so, however, the effect of the bugle; for although the trumpet has been used, in similar situations, for producing a mixed variety of musical sounds, and though artificial situations have been ingeniously devised for obtaining very curious and interesting results, I am not aware of any observation of echoes at all equalling those obtained by the use of the Kent bugle, under the circumstances above described. The first sound you perceive, consists of one or two liquid notes of a simple air, resolving itself into a swelling burst of sweetly blending harmonies, in a manner altogether novel and enchanting. The unmeasured language of "Scenery Guides," often misleads and disappoints the too credulous and excitable traveller; but though I had heard the most rapturous descriptions of the bugle-echoes at the base of the Eagle's Nest, I was yet so astonished and delighted, that the lips of the poor bugleman suffered from the extra service to which he was subjected, whilst we remained on, and revisited, this interesting spot. Possibly, however, the very happy circumstances under which I had the pleasure of visiting Killarney, together with a constitutional fondness for harmony, as well as enjoyment peculiarly excitable by the phenomena of nature, might enhance my delight on this occasion, beyond the experience of travellers in general.

As far as the limited time I could command would permit, I was at some pains to investigate the general principles on which these singular effects depend. And though on the first burst of harmony I was lost in amazement, on account of its singular richness and perfection, the chief properties of sound, to which the phenomena are to be referred, soon became evident. And these appeared simply to be its repercussion from suitable reflecting objects, and its progression through the air, by which the intervals between the direct and the reflected tones of the bugle are occasioned. Assuming the distance of the bugleman from the "Station of Audience," (measured round the point, *p*,) to be 1000 feet; the distance of the principal reflecting surface on the Eagle's Nest, from the same station, 1500 feet; and the reflecting surface from the bugleman 1000 feet; then reckoning the velocity of sound in round numbers at a thousand feet in a second of time, we perceive that whilst the direct sound requires one second for its transmission, the reflected sound having to travel 1000 + 1500 feet, must require about two seconds and a half before the same note reaches the audience, occasioning an interval of a second and a half*. Hence, if an air in crotchets, were played, in which the semi-breve should occupy a second and a half of time, then the third crotchet of the direct sound would exactly coincide with the first crotchet of the echo, so as to produce, in many of the national airs of Scotland and Ireland, which are found to be peculiarly fortunate in their harmonies, a series of concords greatly resembling a regularly composed musical "Canon †."

The general effect of this singular performance, in which the Eagle's Nest takes so important a part, is greatly improved by the concealment of the bugleman. Whilst the audience are stationed in a low situation, near the water's edge at A, the bugleman descends out of sight behind the point of land at B. Here, in a little sheltered spot, close by the river, he executes his simple melodies, which, on their evolution, produce such wonderful and unexpected combinations. The primary tones which reach the auditory, being chiefly those coming round the point along the smooth surface of the stream (the more direct sounds being, probably, scarcely audible, from their being deflected upward into the air, by the vertical side of the river's bank), appear to come out of the cliff, or in the same direction as the echoes, so as to render the auricular deception complete. The Eagle's Nest, indeed, seems to be the seat of a fairy orchestra; and the performance, modulated by the occasional breeze, varied by the less distinct echoes, and accompanied, at the interval of several seconds, by the Eolian harmonies of the distant mountains, which become audible in the more delicate cadences, altogether produce an effect as novel and wonderful as it is diversified and enchanting. It is not to be expected, indeed, that the whole of these accidental combinations form regular concords; yet the dissonances, from the liquid nature of the tones, are far from being disagreeable, while they often serve, like the discords introduced by skilful composers, to heighten the effect of the succeeding harmonies.

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* These distances being derived from a map on a small scale, are not to be considered as the accurate measurements; but they serve sufficiently well for every purpose of illustration.

† The well known melody of "Robin Adair" is a good example of the kind of tune referred to. This air being played at the rate of a crotchet in three-fourths of a second of time, the echo of the first note, *f*, will coincide with the third crotchet, *a*, of the direct sound; the next echo, being *g*, will be simultaneous with *b* flat; the next reflected note, *a*, with *b* flat passing into *c*; and the next, being *b* flat, will coincide with the *d* of the direct sound,—producing thus far, and, indeed, with very few exceptions throughout the air, a series of almost perfect harmonies. It might be curious to try the effect of two bugles playing the air as a canon.

The enjoyment experienced at the "Station of Audience" is varied, by the bugleman repeating a part of his performance at the elevated ground from whence the paterera is discharged. The music elicited there is pleasing, but the deception being taken away, owing to the performer's visibility to the audience, the interest is found to be greatly diminished.

In order to verify the conclusion to which I had come, in respect to the cause of these musical phenomena, I changed situations with the bugleman, stationing him at the usual place of audience, A, and descending myself beneath the bank, B, where he was in the habit of playing. The result of his performance was very similar to what it was in the former case. This, indeed, was fully anticipated, because the interval between the direct sound and the echo was the same—the angles of incidence and reflection similar—and the only difference observable was presumed to arise from the direct sound being less distinctly heard, perhaps, than under the former arrangement.

## *Description of a new Instrument (proposed to be named a Magnetometer), for measuring the different degrees of magnetic intensity that are exhibited during the day, throughout the year, and at various parts of the Globe.* By Mark Watt, Esq. M. W. S., &c. Communicated by the Author.

Having observed that there was no instrument at present for measuring correctly the various degrees of magnetic intensity, which are exhibited at different seasons of the year, and in different parts of the globe, the instrument here described, though simple, sufficiently supplies, I conceive, that desideratum.

If two magnetic needles are placed on two pivots, alongside each other, in the magnetic meridian, at any distance within the sphere of their repulsive powers (say an inch), with similar poles opposite to each other, it is evident that, whether any increase or diminution of their repelling powers takes place or not, it cannot be indicated, as it would affect all the four poles equally; and, therefore, they would always maintain the same relative position.

But if, instead of balancing two needles by their centres, we take two small bars of wood, of three or four inches long, *w w*, *w w*, Plate V. Fig. 9.; insert a smooth capsule into each of these pieces of wood at the distance of an inch from their ends, so that an inch of the wood shall project beyond the capsule; and if, to these ends, we affix two light magnets, *m m*, *m m*, three inches, for example, of the main-spring of a watch made straight, and balance these on two pivots *p p*, in the magnetic meridian, with similar poles opposite to each other, they will then be free to move to any increase or diminution of magnetic influence, and indicate, by their motion, any alteration of the kind by their repelling properties accordingly; for the magnetic meridian acts, in this case, as a common point of attraction to both. When, therefore, they are placed at the distance of two or two and a-half inches from each other, they will be repelled 20° or 25° off from the meridian, and if a scale of degrees is placed beneath the wooden extremities of the two bars, a very great variation in the magnetic intensity takes place, and can readily be observed.

This instrument is formed upon the acknowledged laws, that the repulsive powers of the magnet increase in the same ratio with their attractive powers; and that both increase or decrease with the augmentation or diminution of the magnetic intensity, as variously developed, in different places, on the surface of the globe, and, as this instrument proves, at different seasons of the year.

When, therefore, the magnetic force increases, the magnets are repelled from each other, and diverge farther from the meridian line; and, consequently, the space between the bars of wood, at the other ends of the instrument, (which serve as indices) is contracted. And when the magnetic force is diminished, the magnets are again attracted toward the magnetic meridian, and the space between the indices is increased.

I have observed the indications of an instrument constructed on these principles for nearly a year. The wooden bar, into which an agate capsule was fixed, was four inches long, one inch projected beyond the capsule, to which a light magnet, made of a piece of the mainspring of a watch, was affixed, two and a-half inches long, and balanced by a sliding weight at the other end of the wooden bar. Two of these magnets made exactly similar, with their wooden bars, were placed on two steel pivots, fixed to a stand at the distance of two and a-half inches; and a scale of degrees having been placed beneath the extremities of the wooden bars which move on the pivots, the general mean result has been as follows.

The number of the degrees refer to the space contained between the extremities of the bars of wood the degrees were one-twelfth of an inch each. The instrument was placed under a glass shade.

| | | | | | |
|---|---|---|---|---|---|
| May | 7 | varying to 8° | November | 11 | varying to 14° |
| June | | | December | 12 | |
| July | | | January | 12 | |
| August | 7½ | varying to 11° | February | 11 | varying to 10° |
| September | 8 | | March | 9 | |
| October | 9 | | April | 9 | |

Besides this very great annual variation in the magnetic intensity, there was, during the spring and summer seasons, a daily variation of a degree, and in winter one-half a degree in clear weather And, although the annual variation was developed as I expected, increasing and diminishing in coincidence with the sun's altitude and declination, yet the daily variation was quite the opposite of what I supposed would take place; for the magnets stood a degree nearer each other from 12 M. till 4 P. M.; and, consequently, the indices which stood at 7° during the whole summer all the rest of the 24 hours of the day, extended to 8° between 12 and 4 or 5 P. M. I expected, on the contrary, they would have contracted to 6°, as the magnetic intensity is greatest during these hours. But this phenomenon arises, I conceive, from the mechanical influence of the magnetic current, which, there is every reason to believe, moves over the surface of the earth; and, as it will, like every other fluid of this sort, be in its greatest force when the sun's action is greatest, it might, in opposition to the repelling force of the magnet, bring them nearer the exact direction of the magnetic meridian or line in which the current moves.

But whether this cause assigned be correct or not, I cannot help concluding that all the general results drawn from the observations made hitherto on the magnetic intensity that prevails in different parts of the globe, by the vibrations of the magnet, must necessarily be erroneous, except they were all made in the same season of the year, and at the same time of the day, which, certainly, was not the case: For it is obvious that, on the same spot, there is double the force of magnetic intensity in a clear day in June, to what there is in a frosty day in November. On the 11th of last November, the thermometer standing at 31°, the magnetometer stood at 14°.

Lest the magnets had lost any portion of their strength, two large magnets were passed over them in November; but they had lost no part of it.

## *Notice of an Experiment which proves that the Magnetic Needle does not point North and South; but only when it is suspended in a position approaching to the horizontal, or so that it cannot shew its natural bearings.* By MARK WATT, Esq. M. W. S.[*] Communicated by the Author.

To the extremity of a small slip of wood of any length (three inches for example), let one of the ends of a thin bar of steel of two and a-half inches long be affixed, so that both shall form one straight bar, and let this be balanced in an horizontal position, by a small short cross bar, passing through the other wooden bar at right angles, at the distance of half an inch from the end to which the piece of steel is attached; and let two small pivots be formed at the ends of the cross bar, so that it may vibrate upon two rests like a balance, or dipping needle.

If we then render the thin bar of steel fixed into the wood fully magnetic in the usual way, making the farther extremity the south pole, and that affixed to the wood the north, it will immediately spring up from the horizontal position, and the south pole will point almost straight upwards, towards the zenith, and the north, of course, towards the nadir or centre of the earth. If, then, without altering the bars in any way, we merely reverse the poles by passing the poles of two magnets along them in the opposite direction, the contrary effect is produced; and the farther extremity of the steel bar becoming the north pole, points toward the centre of the earth, and that affixed to the wood upwards causing the other end of the wooden beam to stand upright.

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[*] We recommend Mr Watt to consult the Memoirs and great work on Magnetism by Hansteen.—EDIT.

In making this experiment, it is necessary to attend to the specific lightness of the instrument. The pivots ought to be of smooth steel, and they ought simply to rest on two pieces of glass or polished wire, placed on the top of the supporters of the bar; and nothing ought to touch the extreme points of the pivots, as it prevents, by friction, the perfect developement of the magnet's atttactions. The wood and the steel must also form one perfectly straight bar.

I would remark that, as all our compass needles are made of considerable weight, and suspended by the centre, what we have considered the dip of the needle is merely the tendency the needle evinces to the upright position, the south pole rising, and the north dipping, more or less according to circumstances; but its position and weight prevent it from assuming the perpendicular pointing.

In the memoir which I had the honour of reading last winter before the Wernerian Society, I took the liberty of making the following observations respecting magnetism. That from the phenomena I had observed by means of the solar compass and other experiments; that the magnetic needles were much influenced by the light and heat of the sun; that the south pole seemed attracted *to the sun*, and other celestial bodies; that probably a current of the magnetic fluid was ever in motion over the surface of the globe, as over every other globular magnet, that the magnetic intensity seemed, therefore, more equal near the equator, and that to determine the magnetic intensity by the vibrations of the needle, appeared not a very satisfactory way of ascertaining it; from the effect the contingent causes already mentioned had on the needle. And I conceive that the observations I have made on the magnetometer, and this experiment go far to demonstrate that these suggestions were correct.

I would now add that the south pole of the magnet seems to be attracted by the sun, and the celestial influences which are sent to the earth by the heavenly bodies with their light; and the north seems attracted to the earth, or the terrestrial influences, which it must ever be sending forth by its reflected light, its heat and electricity.

The south pole acts, seemingly, as a constant conductor in the same manner as an iron rod does to the electric fluid. And it is worthy of remark, that all bars of iron become magnetic, not only by simply standing in a perpendicular position, but by having only one end elevated like an inclined plane above the other, and the elevated end is universally the south pole, and the depressed extremity the north. This is even the case with all our fire-irons, the lower ends repelling the north pole of the needle, and the upper the south.

The experiment above stated almost proves that the dip of the north pole of the needle is not caused by any change in the weight, as the needle used is so placed that both the poles are beyond the fulcrum, or points of suspension; and upon the principle of the lever, such a great difference of position would not likely take place. But be this as it may, it does not alter the aspect of the fact stated in respect to the pointing of the needle.

I would farther remark, that it has been mentioned by M. Prevost and other writers, that probably there are two sorts of magnetism; and that the sun was likely the source of one of them.

I conceive that the experiments I have lately detailed, afford us much reason for concluding that this is actually the case. And there are also some grounds for believing that not only the sun, but also the moon and the combined influence of the planets and stars, exert a certain degree of influence on the phenomena of magnetism.

I would therefore beg to state that all the observations I have made, regard principally the solar or celestial magnetism.

The compass, when moving round the globe, in the direction of the meridional lines, seems to preserve nearly that position which it would do, if moving round a ball of iron as proved by Mr Barlow. With this difference, however, that the solar influence in the equatorial regions prevents the needle from either varying or dipping much. Its being equidistant from both poles of the earth may also be a farther cause. But in the higher northern latitudes, the south pole of the needle is apparently attracted to, and affected by, the sun; whilst the opposite takes place near the antarctic regions, as far as we can learn, the south pole then dipping, and the north being most affected by the constant *changes* of solar influence. And it must be owing to some celestial influence that a bar of steel, such as has been described, when made perfectly straight and equally balanced on all sides, stands quite perpendicular when rendered magnetic, though before resting horizontally.

I perceive that Professor Hansteen has also been making observations on the different degrees of magnetic intensity that subsist during the seasons of the year; and though I have not heard by what means he has come to his conclusions, yet I understand they are quite the reverse of those I have formed, viz. that there exists a greater degree of magnetic intensity during winter than in summer, and yet I believe we may both be perfectly correct; for my experiments regard chiefly the solar influence, the two opposing magnets being balanced quite horizontally, while Hansteen's may have been made in respect only to the terrestrial influence; and the latter seems to increase as the former diminishes, and *vice versa;* but a certain proportion of both appears necessary to produce the directive property of the needle, as that property is lost near the north and south poles. The terrestrial magnetism, indeed, most correctly ascertained by the dip; and I mentioned in my paper on the solar compass that in this also there was a small diurnal and annual variation corresponding to the sun's altitude and state of the atmosphere.

Hansteen indeed ascribes the different degrees of magnetic intensity which are developed in the successive months of the year to the solar influence, and supposes that the magnetic intensity is greater in winter than in summer, because the earth is then in its perihelion; but though this is certain in respect to the sun, yet it is no less so, that the influence of the sun in our hemisphere is immensely greater, and its force more powerfully felt by every substance, organic and inorganic, in summer than in winter, though the earth is then in aphelion. I have only to add that my observations were made before I heard of Hansteen's.

## *Human Bones found in the Caves of Bize, near Narbonne.*

By M. Tournal *junior.*

The caves of Bize appear to me to be particularly worthy of attention, because some of the bones which they contain, being of much more recent origin than any fossils hitherto discovered, seem to connect the present geological period with that which preceded historical records. In fact, there are found at Bize, in the same beds, human bones and bones belonging to extinct species, all possessing the same physical and chemical characters. These observations are calculated to bring into doubt the alleged non-existence of man in the fossil state. They cannot be confounded with the gross mystification of the shapeless block of sandstone found at Fountainbleau, or with the human skeletons found at Guadaloupe in a quite recent rock, formed by the agglutination of fragments of madrepores. They bear upon new facts, and tend to prove that, in the present state of science, we cannot, with certainty, say where the regular strata of the globe terminate. The generally admitted proposition that there are no human bones in a fossil state upon our present continents, may therefore be questioned, or at least cannot be substantiated.

It is true that the fragments of earthen-ware, the human bones and modern marine shells, that are found in the caves of Bize, may have been carried there long after by a current of water which, having stirred up the black mud, mixed it with modern materials; but, supposing this latter fact, and I am inclined to admit it, we should have an example of three great currents, which, at different epochs, made their way into the caves of Bize, and carried into them or surprized there the remains of organized beings, which then lived in the neighbourhood.

The caves of Lunel-Vieil, which I have visited along with M. Marcel de Serres, are situated in a tertiary marine limestone, occasionally affecting the globular form. Their entrance is small. The red mud and sand with which they are filled, appear to me to have been deposited at the same epoch as the red mud of the caves of Bize. Bones are rare in them; for, after a long search, even in places which had not been touched, I was unable to procure a single fragment.

At Bize, on the contrary, the caves are situated in the oolite limestone. Their entrance is spacious and of easy access. The interior is immense, and choked up at first with a red mud, similar, as I have said, to that contained in the caves of Lunel-Vieil.

I have not been able to procure many bones from this mud, it being necessary to dig through a bed of black mud before one can get at them. Above the red mud has been deposited the black mud just mentioned. It contains an immense quantity of bones.

This mud is remarkable for its containing, along with human bones, fragments of earthen-ware, modern sea-shells, land-shells, and bones of extinct species.

There are also, in several places of the caves of Bize, osseous brecciæ, which appear to me to be nothing but the red and black mud, cemented by calcareous infiltrations. These brecciæ are found indifferently on the walls, and even at the roof of the caves. A circumstance which has surprized me, and which deserves the greatest attention, is the entire absence of large carnivora, which might have carried in the bones; but these being perfectly free of gnawing, we must reject that opinion.—*Annales des Sc. Nat. December* 1828.

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*Meteorological Table, extracted from the Register kept at Kinfauns Castle, N. Britain.* Lat. 56° 23′ 30″.—Above the level of the Sea, 140 feet. Communicated by Lord GRAY.

| 1828. | MORNING, ½ past 9, *Mean height of* | | EVENING, ½ past 8, *Mean height of* | | Mean Temper. by SIX's Therm. | Depth of Rain in Garden. | No. of days, | |
|---|---|---|---|---|---|---|---|---|
| | BAROM. | THERM. | BAROM. | THERM. | | | Rain or Snow. | Fair. |
| January, | 29.674 | 41.258 | 29.700 | 40.968 | 41.613 | 3.40 | 14 | 17 |
| February, | 29.561 | 41.104 | 29.583 | 40.517 | 41.414 | 3.30 | 18 | 11 |
| March, | 29.645 | 44.774 | 29.629 | 43.484 | 44.355 | 1.00 | 5 | 26 |
| April, | 29.534 | 44.600 | 29.525 | 45.443 | 46.400 | 2.80 | 13 | 17 |
| May, | 29.695 | 55.355 | 29.691 | 50.968 | 53.000 | 2.75 | 15 | 16 |
| June, | 29.715 | 61.000 | 29.739 | 57.000 | 58.567 | 1.90 | 9 | 21 |
| July, | 29.499 | 62.710 | 29.505 | 58.967 | 60.549 | 2.50 | 14 | 17 |
| August, | 29.600 | 60.355 | 29.601 | 58.000 | 59.710 | 4.50 | 13 | 18 |
| September, | 29.732 | 57.267 | 29.736 | 55.167 | 56.200 | 1.50 | 7 | 23 |
| October, | 29.789 | 50.226 | 29.807 | 48.258 | 49.613 | 2.00 | 8 | 23 |
| November, | 29.615 | 46.433 | 29.606 | 45.533 | 46.400 | 5.00 | 17 | 13 |
| December, | 29.529 | 45.226 | 29.543 | 44.806 | 44.806 | 3.00 | 15 | 16 |
| Average of the year, | 29.632 | 56.859 | 29.639 | 49.093 | 50.219 | 33.65 | 148 | 218 |

## ANNUAL RESULTS.

### MORNING.

| BAROMETER. | | | THERMOMETER. | | |
|---|---|---|---|---|---|
| Observations. | Wind. | | | Wind. | |
| Highest, 29th Oct. | SW. | 30.44 | 25th June, | SW. | 69° |
| Lowest, 21st Mar. | W. | 28.59 | 18th February, | SW. | 30° |
| **EVENING.** | | | | | |
| Highest, 28th Oct. | SW. | 30.48 | 22d June, | SW. | 69° |
| Lowest, 21st Mar. | W. | 28.70 | 10th January, | NE. | 28° |

◆

| WEATHER. | Days. |
|---|---|
| Fair, | 218 |
| Rain or Snow, | 148 |
| | 366 |

| WIND. | Times. |
|---|---|
| N. and NE, | 44 |
| E. and SE. | 93 |
| S. and SW. | 146 |
| W. and NW. | 83 |
| | 366 |

◆

*Extreme Cold and Heat, by* Six's *Thermometer.*

| | | | |
|---|---|---|---|
| Coldest, 11th January, | Wind, | NW. | 22° |
| Hottest, 29th June, | do. | SW. | 78° |
| Mean Temperature for the year 1828, | | | 50°.219 |

◆

*Results of Two Rain-Gauges.*

| | In. 100. |
|---|---|
| 1. Centre of Kinfauns Garden, about 20 feet above the level of the sea, | 33.65 |
| 2. Square Tower, Kinfauns Castle, 140 feet, | 34.40 |

## *Description of several New or Rare Plants which have flowered in the neighbourhood of Edinburgh, and chiefly in the Royal Botanic Garden, during the last three months.*

*10th March* 1828.

Acacia lanigera.

A. *lanigera;* villosa, foliis (phyllodiis) lanceolatis acutis rigidis nervosis sulcatis mucronatis: mucrone pungenti, capitulis geminis axillaribus, ramulis superioribus leguminibusve lanuginosis.—*Cunningham, in Field's Geographical Memoirs on New South Wales*, p. 345.

A. *lanigera;* floribus capitatis, capitulis axillaribus, geminis, multifloris; stipulis subulatis, herbaceis, marcescentibus; phyllodiis lanceolato-falcatis, multinerviis, ramulisque lanatis.

Description.—*Shrub* erect, aphyllous; *branches* scarcely angled, erect; *bark* brown and wrinkled, on the young shoots woolly. *Phyllodia* (2½ inches long, 4 lines broad,) lanceolato-falcate, curved downwards, nerved, spreading, stiff, dull green, somewhat woolly, having one gland towards the base on the upper edge, mucronate, mucro rigid, afterwards withering. *Stipules* small, subulate, withering. *Capitula* geminate (sometimes solitary at the points of the branches), axillary, globular, flowers in each numerous, one spreading to each side on a *peduncle*, which is as long as the stamens, and slightly villous. *Bracteæ* ovate, villous, ciliated, marcescent, one sheathing the base of each peduncle, another below each flower, the latter attenuated at the base, and more delicate than the former. *Calyx* colourless, transparent, adpressed, 5-cleft, segments blunt, ciliated. *Corolla* smooth, twice as long as the calyx, 5-cleft; tube transparent, colourless; limb yellowish, spreading, segments pointed, concave. *Stamens* (three lines long) yellow; anthers small, bilobular, lobes round, bursting by a transverse line on their outer sides. *Pistil* awanting in most of the flowers, yellow; stigma minute; style rather longer than the stamens, oblique; germen obscurely pubescent, oval.

We received this plant through the kindness of Mr Aiton from the Royal garden at Kew, in the beginning of 1828. It had been received there from Mr Cunningham under the name now given; and Mr Cunningham says of it, in Field's Memoirs, that it is "a shrub frequent on rocky barren ranges in the interior," between the colony of Port Jackson and the settlement of Bathurst. It flowered freely with us in January and February.

This species probably bears a great resemblance to *A. multinervia*, DC. only known to me, however, by the descriptions in his Memoirs on the *Leguminosæ*, and in the Prodromus; but it differs in being provided with stipulæ, and in the young branches being less angular. The peduncles, too, are probably longer, and the marginal gland perhaps nearer the base of the phyllodium. Further, the woolliness of the phyllodia, and more particularly of the young branches, could scarcely have been overlooked; and as it is not mentioned, I presume it is awanting in *A. multinervia.*

## Billbergia iridifolia.

B. *iridifolia;* foliis lanceolato-ensiformibus, undulatis, acuminatis, inferne spinuloso-serratis; spica pendula, floribus remotis; bracteis longitudine florum, lanceolatis, pedicello adnatis.

B. iridifolia, *Bot. Reg.* 1068.

Bromelia iridifolia, *Nees & Martius*, *Sprengel.*

Description.—Plant without *stem*. *Leaves* (2 feet long) lanceolato-sword-shaped, undulate, quite entire, excepting towards the base, where they have a few distant spinulose teeth, deep green above, whitish below, from minute indistinct scales. *Spike* (with the peduncle, 1 foot 3 inches long) terminal, pendulous, bracteate. *Bracteæ* ovato-lanceolate, acuminate, clasping the lower part of the peduncle where there are no flowers, nearer the apex lanceolate, arising from the pedicels, smaller upwards, as long as the flowers, excepting towards the apex. *Rachis* angular, flexuose, as well as the bracteæ of uniform red colour, and nearly smooth, the lower bracteæ only being tipped with minute white tomentum. *Flowers* (2½ inches long, about 14 in a spike,) distant, divaricated, on very short pedicels. *Calyx* (9 lines long) 3-parted, slightly villous, segments blunt, uniform, adpressed, yellowish-rose coloured, tinged purple at the apex. *Corolla* 3-parted, segments uniform, projecting an inch beyond the calyx, yellow, and beautifully tipped with lilac, the two upper segments reflected, the lower revolute. *Stamens* arising from the base of the corolla, exserted, straight, having two cucullate, fimbriated, nectariferous scales on the inner side of the base of each; filaments inserted into the back of the anthers; anthers orange coloured, linear, versatile, bilobular, and lobes furrowed; pollen orange. *Stigmata* 3, convolute, green, scarcely projecting beyond the stamens. *Style* filiform. *Germen* obovate, slightly furrowed, rose coloured, trilocular. *Ovules* very numerous, small, attached to the central column.

The species is a native of Brazil. We received our specimen from the rich collection in the Botanic Garden at Liverpool in October last. It produced its handsome spike in the stove of the Botanic Garden, Edinburgh, in the beginning of March.

### Stenochilus viscosus.

S. *viscosus;* foliis ovato-lanceolatis, serratis, postice integerrimis, ramulisque nitidis viscosis, floribus axillaribus solitariis.

Description.—*Shrub* erect, bark brown and smooth; young branches subangular, scabrous, glutinous, green. *Leaves* (1½ inch long) scattered, ovato-lanceolate, subacute, coriaceous, rigid, suberect, slightly concave, glutinous, shining, bluntly and distantly tooth-serrated in their upper half, entire behind, obscurely and sparsely veined, middle rib blunt and slightly prominent behind. *Flowers* solitary, axillary, collected towards the extremities of the shoots, longer than the leaves. *Peduncles* (3 lines long) green, filiform. *Calyx* (half an inch long) green, 5-cleft, segments subulate, glutinous within and without, the upper broadest and longest, the two lateral shorter and narrower than those below. *Corolla* (above an inch long) yellow, ringent, curved, pubescent both within and without, and the hairs distilling from their extremities a viscid colourless fluid, bilabiate; upper lip very broad, and folded down by the sides of the flower, 4-toothed, teeth subulate, those at the side reflected and their apexes approaching behind the two in the centre, which are erect, with their apexes somewhat spreading; lower lip much more narrow, linear, entire, blunt, revolute; tube inflated at its base, nectariferous. *Stamens* didynamous, arising from the inflated portion of the tube, exserted (projecting half an inch beyond the corolla); filaments thread-like, nearly straight, yellow, inserted into the back of the anthers; anthers oblong, bilobular, with a rounded continuous border, lobes bursting in front; pollen yellow. *Stigma* minute, blunt, cleft, greenish. *Style* purple, filiform, (4½ lines) longer than the stamens, over which it is curved. *Germen* ovate, slightly flattened, yellow, greenish towards its apex.

The species is a native of New Holland, from whence seeds were imported by F. Henchman, Esq. and plants raised by Mr Mackay in his nursery at Clapton, along with many other additions to our greenhouses from the same quarter. The specimen above described was kindly communicated by him to the Royal Botanic Garden, Edinburgh, in October last, It flowered in the beginning of March.

### Tradescantia crassula.

T. *crassula;* caule ascendente, radicante, ramoso, glabro; foliis vaginantibus, oblongo-lanceolatis, utrinque nitidis, glaberrimis, integerrimis, nervosis, vaginisque adpressis ciliatis; umbellis simplicibus, axillaribus terminalibusque, pedunculatis sessilibusque, subsolitariis, pedunculis angulatis, pedicellisque nitidis; filamentis basi lanatis.

Description.—*Stem* (3 feet long) stout, succulent, ascending, rooting at the joints, smooth and shining, green, occasionally purple, especially at the joints. *Leaves* (4–9 inches long, 1–2 broad), alternate, fleshy, oblongo-lanceolate, mucronate when young, but soon withering at the tip, bent back, slightly channelled in the middle, and reflexed at the sides, naked and shining on both sides, sheathing, ciliated, especially when young, and at the base: *sheaths* (half an inch long), shortest in the upper leaves, ciliated, adpressed. *Umbels* simple, many-flowered, axillary, peduncled, the uppermost but one generally sessile, solitary, or two together, of unequal heights; *involucrum* of two opposite, unequal, ovate leafets, resembling the ordinary leaves of the plant; *peduncles* (1–3 inches long) angular, straight, smooth and shining; *pedicels* (fully half an inch long) like the peduncles, but reflected when the flower has faded. *Calyx* of three green, boat-shaped, spreading leafets, hairy upon the whole of their outer surface, except a narrow, transparent, membranous edge, hairs tapering, simple, transparent, colourless, arising from slight glandular elevations. *Corolla* (little more than half an inch across) of three flat, spreading, ovate petals, pure white, and twice as long as the calyx, every where smooth. *Stamens* six, erect, shorter than the corolla; filaments colourless, smooth, excepting at the base, where each is surrounded with a tuft of jointed colourless hairs, as long as itself; anthers orange coloured, kidney-shaped, loculaments distant, bursting at the edge; pollen yellow. *Pistil* single, white; stigma small; style longer than the stamens, tapering both above and below; germen obovate, trigonous, trilocular.

We received, at the Royal Botanic Garden, from Berlin, a plant of this species, under the name of *T. crassula*, Link, in June 1828, and another from Robert Barclay, Esq. Buryhill, in October following, under the name of *T. crassipes*. I adopt the former, from an apprehension that it may be already published in some work which I have not seen. The plants flowered in the stove in December and January last. They have not produced seed, but will be easily propagated by their rooting stem. I have no information regarding the native country of the species.

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## *Celestial Phenomena from April 1. to July 1. 1829, calculated for the Meridian of Edinburgh, Mean Time.* By Mr George Innes, Aberdeen.

**The times are inserted according to the Civil reckoning, the day beginning at midnight.—The Conjunctions of the Moon with the Stars are given in *Right Ascension*.**

### APRIL.

| D. | H. | ′ | ″ | |
|---|---|---|---|---|
| 1. | 14 | 6 | 41 | ☿ near φ ♒ |
| 1. | 23 | 24 | – | ☌ ☽ ☿ |
| 2. | 23 | 44 | 42 | ☌ ☽ ♀ |
| 3. | 22 | 11 | 47 | ● New Moon. |
| 4. | 16 | 50 | 10 | ☌ ☽ ο ♓ |
| 7. | 1 | 37 | 19 | ☌ ☽ ♂ |
| 7. | 11 | 5 | 12 | ☌ ☽ 1 δ ♉ |
| 7. | 11 | 35 | 4 | ☌ ☽ 2 δ ♉ |
| 7. | 16 | 40 | 15 | ♃ near α ♉ |
| 9. | 1 | 5 | 8 | Em. III. sat. ♃ |
| 9. | 1 | 59 | 36 | Im. II. sat. ♃ |
| 10. | 0 | 53 | 59 | Im. I. sat. ♃ |
| 10. | 2 | 38 | 21 | ☌ ♂ A ♉ |
| 11. | 1 | 55 | 47 | ☽ First Quarter. |
| 11. | 14 | 56 | 14 | ☌ ☽ ♄ |
| 12. | 16 | 43 | 7 | ☌ ☽ 1 α ♋ |
| 12. | 18 | 0 | 56 | ☌ ☽ 2 α ♋ |
| 13. | 11 | 34 | 52 | ☌ ☽ ξ ♌ |
| 13. | 15 | 51 | 49 | ☌ ☽ ο ♌ |
| 14. | 1 | 47 | 24 | ☌ ☽ π ♌ |
| 16. | 0 | 7 | 35 | ☌ ☽ τ ♌ |
| 16. | 2 | 41 | 16 | Im. III. sat. ♃ |
| 16. | 8 | 46 | 31 | ☌ ♀ ζ ♓ |
| 17. | 2 | 47 | 41 | Im. I. sat. ♃ |
| 17. | 9 | 52 | 39 | ♂ near κ ♉ |
| 18. | 5 | 24 | 39 | ☌ ☽ ϑ ♍ |
| 19. | 6 | 8 | 25 | ○ Full Moon. |
| 19. | 12 | 49 | 39 | ☌ ☽ κ ♍ |
| 20. | 8 | 53 | 21 | ☉ enters ♉ |
| 21. | 3 | 54 | 0 | ☌ ☽ γ ♎ |
| 21. | 12 | 11 | 52 | ☌ ☽ ϑ ♎ |
| 22. | 4 | 56 | 21 | ☌ ☽ φ Oph. |
| 22. | 19 | 55 | 42 | ☌ ☽ ♃ |
| 23. | 1 | 13 | – | ♀ near ο ♓ |
| 26. | 7 | 10 | 6 | ☌ ☽ β ♑ |
| 26. | 14 | 40 | 7 | ☾ Last Quarter. |
| 26. | 15 | 21 | 25 | ☌ ☽ ♅ |
| 27. | 13 | 8 | 22 | ☿ near ο ♓ |
| 28. | 8 | 51 | 35 | ☌ ☽ ϑ ♒ |

### MAY.

| D. | H. | ′ | ″ | |
|---|---|---|---|---|
| 1. | 13 | 21 | 43 | ☌ ☽ ζ ♓ |
| 2. | 2 | 52 | 45 | ☌ ☽ ο ♓ |
| 2. | 20 | 38 | – | ☌ ☽ ☿ |
| 2. | 22 | 49 | 49 | ☌ ☽ ♀ |
| 3. | 1 | 3 | 55 | Im. I. sat. ♃ |
| 3. | 7 | 40 | 44 | ● New Moon. |
| 3. | 22 | 55 | 39 | Im. II. sat. ♃ |
| 4. | 7 | 51 | – | ☌ ☿ ♀ |
| 4. | 21 | 4 | 44 | ☌ ☽ 1 δ ♉ |
| 4. | 21 | 34 | 42 | ☌ ☽ 2 δ ♉ |
| 5. | 2 | 41 | 7 | ☌ ☽ α ♉ |
| 5. | 21 | 17 | 54 | ☌ ☽ ♂ |
| 7. | 16 | 59 | 53 | Em. III. sat. ♃ |
| 8. | 1 | 30 | – | Sup. ☌ ☉ ☿ |
| 9. | 1 | 39 | 24 | ☌ ☽ ♄ |
| 10. | 1 | 43 | 15 | ☌ ☽ 2 α ♋ |
| 10. | 2 | 57 | 56 | Im. I. sat. ♃ |
| 10. | 18 | 38 | 21 | ☌ ☽ ξ ♌ |
| 10. | 19 | 19 | 24 | ☽ First Quarter. |
| 10. | 23 | 23 | 23 | ☌ ☽ ο ♌ |
| 11. | 1 | 29 | 5 | Im. II. sat. ♃ |
| 11. | 9 | 13 | 50 | ☌ ☽ π ♌ |
| 13. | 7 | 35 | 14 | ☌ ☽ ρ ♌ |
| 14. | 11 | 41 | – | ☌ ☿ A ♉ |
| 14. | 20 | 58 | 54 | Em. III. sat. ♃ |
| 15. | 12 | 59 | 52 | ☌ ☽ ϑ ♍ |
| 16. | 11 | 41 | – | ♂ near 132 ♉ |
| 16. | 20 | 20 | 48 | ☌ ☽ κ ♍ |
| 16. | 20 | 30 | – | ☌ ☿ 2 κ ♉ |
| 18. | 11 | 4 | 0 | ☌ ☽ γ ♎ |
| 18. | 19 | 14 | 47 | ☌ ☽ ϑ ♎ |
| 18. | 19 | 31 | 38 | ○ Full Moon. |
| 18. | 23 | 20 | 35 | Im. I. sat. ♃ |
| 19. | 11 | 43 | 30 | ☌ ☽ φ Oph. |
| 19. | 21 | 44 | 45 | ☌ ☽ ♃ |
| 20. | 20 | 0 | – | Sup. ☌ ☉ ♀ |
| 21. | 9 | 14 | 29 | ☉ enters ♊ |
| 21. | 22 | 32 | 22 | Im. III. sat. ♃ |
| 22. | 0 | 58 | 8 | Em. III. sat. ♃ |
| 23. | 12 | 26 | 14 | ☌ ☽ β ♑ |
| 23. | 20 | 30 | 40 | ☌ ☽ ♅ |
| 25. | 14 | 25 | 17 | ☌ ☽ ϑ ♒ |
| 25. | 20 | 3 | 20 | ☾ Last Quarter. |
| 26. | 1 | 14 | 51 | Im. I. sat. ♃ |
| 27. | 1 | 0 | – | ☌ ☿ 132 ♉ |
| 28. | 20 | 46 | 52 | ☌ ☽ ζ ♓ |
| 29. | 2 | 30 | 32 | Im. III. sat. ♃ |
| 29. | 4 | 57 | 4 | Em. III. sat. ♃ |
| 29. | 10 | 40 | 42 | ☌ ☽ ο ♓ |

### JUNE.

| D. | H. | ′ | ″ | |
|---|---|---|---|---|
| 1. | 5 | 0 | – | ☍ ☉ ♃ |
| 1. | 11 | 50 | 26 | ☌ ☽ α ♉ |
| 1. | 17 | 33 | 44 | ● New Moon. |
| 1. | 23 | 53 | 58 | ☌ ☽ ♀ |
| 3. | 15 | 0 | – | ☌ ☽ ☿ |
| 3. | 16 | 25 | 29 | ☌ ☽ ♂ |
| 3. | 23 | 47 | 20 | Em. I. sat. ♃ |
| 4. | 18 | 10 | 6 | ☌ ♂ ι ♊ |
| 4. | 23 | 20 | – | ☌ ☿ ι ♊ |
| 5. | 0 | 53 | 58 | Em. II. sat. ♃ |
| 5. | 4 | 8 | – | ☌ ☿ ♂ |
| 5. | 6 | 28 | 45 | Im. III. sat. ♃ |
| 5. | 14 | 46 | 56 | ☌ ☽ ♄ |
| 6. | 9 | 54 | 45 | ☌ ☽ 2 α ♋ |
| 7. | 2 | 38 | 23 | ☌ ☽ ξ ♌ |
| 7. | 7 | 21 | 44 | ☌ ☽ ο ♌ |
| 7. | 17 | 9 | 36 | ☌ ☽ π ♌ |
| 8. | . | . | . . | ☿ greatest elong. |
| 9. | 13 | 9 | 2 | ☽ First Quarter. |
| 9. | 15 | 22 | 24 | ☌ ♀ ρ ♌ |
| 10. | 16 | 29 | 46 | ☌ ♀ 132 ♉ |
| 11. | 1 | 41 | 53 | Em. I. sat. ♃ |
| 11. | 21 | 8 | 3 | ☌ ☽ ϑ ♍ |
| 12. | 10 | 27 | 18 | Im. III. sat. ♃ |
| 13. | 4 | 44 | 0 | ☌ ♃ κ ♍ |
| 14. | 6 | 11 | – | ☌ ☿ ϑ ♊ |
| 14. | 19 | 33 | 35 | ☌ ☽ γ ♎ |
| 15. | 3 | 42 | 22 | ☌ ☽ ϑ ♎ |
| 15. | 20 | 5 | 51 | ☌ ☽ φ Oph. |
| 15. | 23 | 54 | 0 | ☌ ☽ ♃ |
| 17. | 6 | 2 | 46 | ○ Full Moon. |
| 17. | 17 | 31 | 36 | ☌ ♂ ϑ ♊ |
| 19. | 14 | 26 | 3 | Im. III. sat. ♃ |
| 19. | 18 | 58 | 18 | ☌ ☽ β ♑ |
| 19. | 22 | 5 | 12 | Em. I. sat. ♃ |
| 20. | 1 | 55 | 58 | ☌ ☽ ♅ |
| 20. | 21 | 29 | 37 | ☌ ♀ ι ♊ |
| 21. | 17 | 56 | 28 | ☉ enters ♋ |
| 21. | 19 | 51 | 29 | ☌ ☽ ϑ ♒ |
| 24. | 0 | 45 | 35 | ☾ Last Quarter. |
| 25. | 2 | 17 | 23 | ☌ ☽ ζ ♓ |
| 25. | 16 | 25 | 17 | ☌ ☽ ο ♓ |
| 26. | 18 | 25 | 32 | Im. III. sat. ♃ |
| 27. | 0 | 0 | 0 | Em. I. sat. ♃ |
| 27. | 16 | 55 | 25 | ☌ ♀ δ ♊ |
| 28. | 13 | 19 | 54 | ☌ ☽ 1 δ ♉ |
| 28. | 13 | 50 | 15 | ☌ ☽ 2 δ ♉ |
| 28. | 18 | 59 | 54 | ☌ ☽ α ♉ |
| 29. | 21 | 55 | 58 | Em. II. sat. ♃ |

### *Times of the Planets passing the Meridian.*

**APRIL.**

| D. | Mercury. | Venus. | Mars. | Jupiter. | Saturn. | Georgian. |
|---|---|---|---|---|---|---|
|  | H. ′ | H. ′ | H. ′ | H. ′ | H. ′ | H. ′ |
| 1 | 10 26 | 11 19 | 14 52 | 4 20 | 19 19 | 7 55 |
| 5 | 10 30 | 11 21 | 14 48 | 4 3 | 19 3 | 7 40 |
| 10 | 10 36 | 11 24 | 14 42 | 3 43 | 18 43 | 7 22 |
| 15 | 10 45 | 11 27 | 14 36 | 3 23 | 18 25 | 7 5 |
| 20 | 10 56 | 11 31 | 14 30 | 3 2 | 18 6 | 6 42 |
| 25 | 11 9 | 11 34 | 14 25 | 2 24 | 17 47 | 6 19 |

**MAY.**

| D. | Mercury. | Venus. | Mars. | Jupiter. | Saturn. | Georgian. |
|---|---|---|---|---|---|---|
|  | H. ′ | H. ′ | H. ′ | H. ′ | H. ′ | H. ′ |
| 1 | 11 29 | 11 40 | 14 19 | 2 14 | 17 25 | 6 0 |
| 5 | 11 45 | 11 42 | 14 15 | 1 58 | 17 14 | 5 45 |
| 10 | 12 7 | 11 46 | 14 9 | 1 36 | 16 53 | 5 25 |
| 15 | 12 32 | 11 51 | 14 4 | 1 15 | 16 34 | 5 5 |
| 20 | 12 57 | 11 56 | 13 58 | 0 52 | 16 16 | 4 45 |
| 25 | 13 16 | 12 2 | 13 53 | 0 30 | 15 59 | 4 26 |

**JUNE.**

| D. | Mercury. | Venus. | Mars. | Jupiter. | Saturn. | Georgian. |
|---|---|---|---|---|---|---|
|  | H. ′ | H. ′ | H. ′ | H. ′ | H. ′ | H. ′ |
| 1 | 13 36 | 12 11 | 13 46 | 23 55 | 15 34 | 3 58 |
| 5 | 13 41 | 12 16 | 13 41 | 23 37 | 15 19 | 3 41 |
| 10 | 13 44 | 12 24 | 13 35 | 23 14 | 15 2 | 3 20 |
| 15 | 13 38 | 12 31 | 13 29 | 22 52 | 14 45 | 3 0 |
| 20 | 13 22 | 12 37 | 13 23 | 22 30 | 14 24 | 2 41 |
| 25 | 13 4 | 12 45 | 13 18 | 22 4 | 14 6 | 2 20 |

## *Proceedings of the Wernerian Natural History Society.* (Continued from p. 181.)

1828, *Dec.* 13.—G. A. Walker Arnott, Esq. V. P. in the chair. The Secretary read the description of a new Instrument for measuring the different degrees of magnetic intensity; communicated by Mark Watt, Esq. Likewise the first part of a paper on the political and geological state of the Meywar country in India, communicated by James Hardie, Esq., Secretary to the Medical and Physical Society of Calcutta. At this meeting, the Reverend J. G. Macvicar exhibited a specimen of the Toothed Gilt-head of Pennant, which had been taken alive in the Bay of St Andrew's.

1829, *Jan.* 17.—Henry Witham, V. P. in the chair. The Reverend J. G. Macvicar read a paper on the rotatory motion of Molecules. The object of the author was to shew, that, from the relation which subsists between the two forces, magnetism and electricity, rotation must result in every body composed of particles, externally and internally heterogeneous, and also in a a homogeneous body in a dissimilar medium. After rotation has been established, then, though the body should be spherical, and there exist no circumstance in its form to determine the direction of its magnetic axis, or axis of symmetry, he endeavoured to shew that this axis is developed in the line of the axis of rotation, which imparts to the body a tendency to move towards another presenting a consecutive pole, or susceptible of such attraction; and that hence a motion of progression, as well as rotation, will be established.

*Jan.* 31.—G. A. Walker Arnott, V. P. in the chair. The Secretary read Mr James Wilson's Essay on the Origin and Natural History of the breed of domestic Dogs, the object of which was to prove that the southern kinds have probably derived their origin from the jackall, and the northern from the wolf. The Reverend Dr Scot of Corstorphine then read a paper on the pelican of the Sacred Writings.

*Feb.* 14.—Robert Stevenson, Esq. Civil Engineer (formerly V. P.), in the chair.—Professor Jameson read extracts from a paper on the geology of the Snowdon range of mountains, as connected with its scenery, soil, and productions, by James Stewart Menteath, Esq. younger of Closeburn. The Reverend Dr Scot then read a communication on the Gourd of Jonah, shewing that it was probably the *Ricinus Palma Christi*, or Castor-oil plant of modern times. At the same meeting, the Secretary read a notice regarding the habits of the *Ornithorynchus paradoxus*, by Thomas Axford, Esq. of Thorpe, New South Wales; communicated by Mr Robert Neill of Hobart Town, Van Dieman's Land.

# SCIENTIFIC INTELLIGENCE.

## METEOROLOGY.

1. *Aurora Borealis.*—A paper was read at the Royal Society, Jan. 29. 1824, on a definite arrangement and order of the appearance and progress of the Aurora Borealis, and on its height above the surface of the earth; by the Reverend James Farquharson, minister of the parish of Alford, in Aberdeenshire; communicated by the author. The results of the numerous observations of the author on the Aurora Borealis, which on several occasions were made under very favourable circumstances, had already been announced in a short paper published in 1823 in the Edinburgh Philosophical Journal; and it was concluded from them, that the Aurora Borealis has in all cases a determinate arrangement and figure, and follows an invariable order in its appearance and progress; that the pencils of rays, or streamers as they are called, generally make their first appearance in the north, and, as they rise from the horizon, assume the form of an arch, extending from east to west, and having its vertex in the plane of the magnetic meridian; the arch itself being at right angles to the plane. While the arch is near the horizon, its breadth from north to south is considerable, and the streamers of which it is composed appear to be nearly at right angles to the general line of the arch, their directions converging to a point a few degrees to the south of the zenith. As the earth moves forward towards the zenith, its lateral dimensions appear to contract, the intensity of its light increases, and the direction of the streamers still tending to the same point in the heavens, approaches more nearly to parallelism with that of the arch. When it has passed the zenith, and arrived at the above mentioned point, a little to the south of the zenith, the arch is seen as a narrow belt, three or four degrees only in breadth, and with well defined edges. In its further progress southwards, it again enlarges in breadth, and exhibits in a reverse order the same succession of changes as before. Hence the author concludes, that the streamers have individually a position nearly vertical, or parallel to the magnetic dip; and they form a thin fringe, stretching often to a great distance from east to west, at

right angles to the magnetic meridian, and that the movement of the fringe from north to south takes place by the extinction of streamers at its northern side, and the formation of new ones contiguous to its southern side. From a variety of observations which were detailed in this paper, the author infers, in opposition to the opinion of Mr Dalton, that the region occupied by this meteor is above, but contiguous to that of, the clouds, or at least to that in which aqueous vapour is condensed, so as afterwards to appear in the form of clouds. The height of this region he estimates as in general about two thousand feet above the surface; and he is of opinion, that, while such is the height of the lower ends of the vertical streamers, their upper ends may have an elevation of two or three thousand feet more.

## CHEMISTRY.

2. *Grease of Wool.*—M. Chevreul read a memoir on the fat matter of wool to the Academy of Sciences, on the 8th of September 1828. The facts exposed in this memoir are detached from an extensive investigation of the principal varieties of wool, with respect to their immediate composition, with the view of appreciating the influence of the different substances which they may contain, and which are foreign to their tissue. The author has extracted from Merino wool, previously washed in pure water, at least $\frac{18}{100}$ of fat matter. It was principally to this matter that he called the attention of the Society in the memoir which he presented to it. It is formed of at least two immediate principles, which differ from each other in their degree of liquefaction. The one at the ordinary temperature, is like wax; while the other, in the same circumstances, is like prepared turpentine. Both form emulsions with water, and in this respect they differ from stearine and oleine, and approach the fat matter of the brain. On keeping them over the fire, in circumstances where oleine and stearine would be converted into soap, the immediate principles of the fat matter of the wool are not saponified. These principles did not appear to be azotized, as is the fat matter of the brain. It is remarkable that the tissue of wool which has been deprived of $\frac{18}{100}$ of fat matter, does not shew itself much more apt to be dyed than it was before, as might have been imagined, from what is admitted respecting the

necessity of cleaning wool before dyeing it. The wool which has lost its fat matter, contains the sulphur which is remarked in wool in its original state; and both kinds, on being treated with alum and tartar, disengage hydro-sulphuric acid. It is to the sulphur contained in wool that the phenomena of coloration are to be attributed which it presents, when it is heated in a solution of acetate of lead, of acetate of alumina holding acetate of lead, protochloride of tin, &c.

## MINERALOGY.

3. *Discovery of Emerald-green and deep Violet-blue Fluor-spar in Banffshire.*—In 1823, Mr G. C. Smith, land-surveyor, Banff, while surveying part of the Duke of Gordon's property in the upper district of Banffshire, found fragments of deep emerald-green and deep violet-blue fluor-spar lying in the bed of the river Avon above Tomintoul. He traced it up the north-west side of the river to Gaulrig, about half-way between Tomintoul and Inchrory, where he found a considerable quantity of loose pieces. The fluor-spar seems to have been detached by the water from some limestone beds lying in the mica-slate of that district. Of this new locality of a rare Scottish mineral, we hope soon to be able to give a more particular description. Calc-tuff, with beautiful impressions of leaves, was found at the same time by Mr Smith, in a large mass close upon Inchrory.

## GEOLOGY.

4. *Organic Remains in Sussex.*—Mr Gideon Mantell, F. R. S. of Lewes, in Sussex, has laid before the Geological Society of London, a catalogue of the organic remains discovered by him in that county. The strata of Sussex are comprehended in two principal groups, the first or uppermost of which contains marine deposites, viz. the Chalk, Galt or Shanklin sand; the second, or lowermost formation, is fresh water, and comprises the Hastings strata, with their subordinate divisions, the Weald clay, Tilgate Grit, and Ashburnham limestones. The organic remains are distributed in these formations as follows:

| | Marine Deposites. | Fresh Water or Lacustrine Deposites. |
|---|---|---|
| Zoophyta and Radiata, | 54 species. | none. |
| Crustacea, | 11 | none. |
| Testacea.—Nautilidæ, the ancient marine multilocular genera, | 50 | none |
| Bivalves and univalves, marine, | 189 | none. |
| Confervæ, fuci, &c. | 3 or more | none. |
| Terrestrial vegetables, | none | 7 or more species. |
| Terrestrial and lacustrine reptiles, | none | 7 or more |
| Fresh water.—Univalve and bivalve testacea, | none | 22 |
| Birds, | none | 2 or more. |

It cannot fail to be perceived from the above abstract, how much greater the number of species contained in the marine deposites is than in those of fresh water or lacustrine origin: thus, the marine have furnished 240 species of shells, while the fresh water strata have afforded but twenty-two species, &c.—A. B.

5. *Histoire des Végetaux Fossiles, par M. Adolphe Brongniart.*—The second *livraison* of this interesting work has reached this country. It contains scientific descriptions of the fossil vegetables belonging to the genera Muscites, Equisetum and Calamites, and is illustrated by thirteen lithographic plates, two of which are of folio size. These are exceeding well executed, and appear to be drawn with every requisite attention to those minute details so essential in representations of this kind. A *prodromus* of this work has just appeared. It gives a general view of the classification of fossil vegetables, and an interesting essay on their geological distribution.

6. *Fossil Saurians of Würtemberg.*—Professor Jæger of Stuttgard, has lately published figures and descriptions of the remains of Saurian animals found in the kingdom of Würtemberg. He has discovered in a deposite equivalent to the Lias of England, the remains not only of the Ichthyosaurus platyodon, communis, intermedius, and tenuirostris; but also of several unknown herbivorous reptiles. Two of these he has described under the names of Cylindricodon, and Cubicodon, from the form of their teeth.

7. *Claw of the Iguanodon.*—Among the remains of Saurian animals, discovered by Mr Mantell of Lewis, during the

present year, in the Hastings strata of Sussex, are two specimens, which Baron Cuvier has determined to be the ungual, or distal phalangeal bones (*phalanges ungueales*) of the Iguanodon; the bones which form the extremities of the toes and support the nails. In their general form, these fossils resemble the analogous bones of the iguana, but are of a magnitude corresponding to the teeth, vertebræ, &c. of this extraordinary fossil reptile, previously discovered in Tilgate forest. The articulating surface of the largest specimen measures 2$\frac{3}{4}$th inches in its longest diameter; the same part in an iguana 3 feet long, does not exceed $\frac{5}{10}$ths of an inch. The length of the fossil, when entire, must have been nearly four inches, that of the recent bone is but $\frac{2}{3}$ths of an inch.—A. B.

## ZOOLOGY.

8. *Fishes that travel on the Land.—Doras costata, or Hassar.*—This species is one of those fishes which possess the singular property of deserting the water, and travelling over land. In those terrestrial excursions, large droves of the species are frequently met with during very dry seasons, for it is only at such periods that they are compelled to this dangerous march, which exposes them as a prey to so many and such various enemies. When the water is leaving the pools in which they commonly reside, the *yarrows* (a species of *Esox* Lin.), as well as the second species of *Hassar*, to which I shall presently refer, bury themselves in the mud, while all the other fishes perish for want of their natural element, or are picked up by rapacious birds, &c. The *flat headed hassars*, on the contrary, simultaneously quit the place, and march over land in search of water [*], travelling for a whole night, as is asserted by the Indians, in search of their object. I have ascertained, by trial, that they will live many hours out of water, even when exposed to the sun's rays. Their motion over land is described to be somewhat like that of the two-footed *lizard*. They project themselves forward on their bony arms, by the elastic spring of the tail exerted sidewise.

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[*] In an excursion made by my friend Mr Campbell, of Sparta Estate, Essequibo, with his family to the sand-reefs, a spot situated about six miles a-back of the sea-coast, they fell in with a drove of these animals, which were on their march overland to a branch of the Pomeroon. They were so numerous that the Negroes filled several baskets with those they picked up.

Their progress is nearly as fast as a man will leisurely walk. The strong *scuta* or bands which envelope their body, must greatly facilitate their march, in the manner of the plates under the belly of serpents, which are raised and depressed by a voluntary power, in some measure performing the office of feet. It is said that the other species, the *round head*, has not been known to attempt such excursions, although it is capable of living a long time out of its element; but as I before observed, it buries itself in the mud in the manner of the *yarrows*, when the water is drying up. The Indians say that these fishes carry water within them for a supply on their journey. There appears to be some truth in this statement; for I have observed that the bodies of the *hassars* do not get dry like those of other fishes when taken out of the water: and if the moisture be absorbed, or they are wiped dry with a cloth, they have such a power of secretion, that they became instantly moist again. Indeed it it scarcely possible to dry the surface while the fish is living *.—*Dr Hancock.*

9. *Fishes Nests.* — It is asserted by naturalists that no fishes are known to take any care of their offspring; both the before-mentioned species of hassar, however, make a regular nest, in which they lay their eggs in a flattened cluster, and

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* On inspecting an old journal, which was kept during a tour to the Parmia, in 1810, I find that another species of these mailed fishes inhabits the rapids of the Essequibo (interior of Guiana), one of which was caught by the Indians whilst employed in hauling our canoes over the falls of that river, and attracted my attention by its curious structure and vivid colouring. It is remarked in the note alluded to, that this fish is not only furnished with the common appendages for swimming, but also with four strong bony supports, one attached to each of the pectoral and belly-fins, (*i. e.* constituting the first ray of each), by which the animal creeps on the bottom of the river, and perhaps where there is little or no water also, being, as it seems, partly amphibious; for although it had received a severe wound on the head, it did not expire till it had been many hours out of the water. It has no proper teeth, but short flexible, curved spines (or *setæ*) on the lips; one row on the upper, and two on the under lip, (the upper jaw short and moveable). The pectoral fin has six *radii*, besides the leg, if I may so term it, or ambulatory spine. The head, and whole body, except the *thorax*, are guarded by a coat of mail, consisting of strong bony plates, supporting four longitudinal rows of curved spines on each side; colour of the body bright reddish yellow, elegantly variegated with black spots; the fin red at the extremities. It grows to about a foot in length.

cover them over most carefully. Their care does not end here. They remain by the side of the nest till the spawn is hatched, with as much solicitude as a hen guards her eggs; both the male and female *hassar* (a species of Doras), for they are monogamous, steadily watching the spawn, and courageously attacking the assailant. Hence the negroes frequently take them by putting their hands into the water close to the nest; on agitating which the male *hassar* springs furiously at them, and is thus captured. The *round-head* forms its nest of grass, the *flat-head* of leaves. Both at certain seasons burrow in the bank. They lay their eggs only in wet weather. I have been surprised to observe the sudden appearance of numerous nests in a morning after rain occurs, the spot being indicated by a bunch of froth, which appears on the surface of the water, over the nest. Below this are the eggs, placed on a bunch of fallen leaves or grass, if it be the littoral species, which they cut and collect together. By what means this is effected seems rather mysterious, as the species are destitute of cutting teeth. It may possibly be by the use of their serrated arms, which form the first ray of the pectoral fins *.—*Dr Hancock*, *Zool. Jour.* No. xiv.

10. *Notice of the discovery of a recent Encrinus.*—From the mutilated state of the recent *Pentacrinites* discovered in the Caribæan seas, it has been impossible to ascertain whether they were attached by the base to rocks, or were capable of locomotion, which the length of the pillar in some of these animals might seem to render unnecessary. The accidental capture of a small but perfect *Encrinus*, has enabled me to settle this point, and has confirmed the suspicion which has been entertained of late, that the species of the tribe *Crinoidea* are allied to that division of the Linnean *Asteriadæ* which have dichotomous and multi-articulate arms. The sessile genera of the *Crinoidea* differ from these, in possessing clasping organs of motion (*ambulacra*), independent of the arms for entangling the prey: and those genera which are furnished with a multiarticulate column beneath the body further differ (in the genus *Pentacrinus* at least), in having supplementary verticillate tendril-like organs

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* Through the attention of Sir David Milne, we have received specimens of fishes nests, constructed amongst fuci on the coast of Berwickshire, of which we may afterwards give a particular description.—Edit.

(*claviculæ*, Ray) on the column, for clasping the branches of *Gorgoniæ*, and other bodies to which they attach themselves, while the arms are kept expanded to receive the food. Of the tribe *Stelleridæ* (all of which want the ambulacra and claviculæ) some, as the solid *Asterias*, have only suckers and accompanying lateral scales for locomotion ; in *Ophiura* the pediform arms, few and multiarticulate, are adapted for walking, but not for the capture of its prey ; in *Gorgonia cephalus*, Leach, they are infinitely dichotomous and ramulose, and suited for both purposes. In all the stomach is central, and either concealed or submembranaceous, and fixed between the brachia. In the *Stellerida*, the surface of articulation in the joints is simple, and the perforation rude ; while, in the *Crinoidea*, the surface is beautifully radiate or stellate, and the muscular foramen well defined. The following short characters may for the present serve for the genus before me, which comes near perhaps to the Stag's-horn Encrinite of Parkinson. I shall forbear publishing any figure or detailed description of this most interesting animal, until I have received an answer from Mr Miller, from whom I hope to ascertain into what families and genera he has divided these multiform beings, in his work on the Crinoidea, which I have no opportunity of consulting here.

*Genus Enorinus*, Miller.—*Char. Gen.* Corpus liberum, crustaceum ; basis solida, subtus suffulta, ambulacris 18, multi-articulatis, prehensoriis ; articulis uniformibus, apice uncinato, *uncinulo* adjuncto. *Brachia* superna, quinque, longissima, cito bipartita, multi-articulata, articulis difformibus ; articulorum facie subcirculari, radiata ; foramine parvo, simplici ; intus digitata. *Digiti* subulati, articulati, numerosi, basi carne nidulantes. *Abdomen* membranaceum, inter brachiorum basin situm. *Os* superum.—*L. Guild. Zool. Journ.* No. xiv.

11. *Notice regarding the Ornithorynchus.*—The place of the principal resort of the ornithorynchus is the district near to the town of Bothwell. I think the animal much more allied to the class of quadrupeds than to that of birds, its food being found amongst weeds, and in marshes; it is indeed furnished with a horny bill, resembling in shape that of a duck, but it has no other resemblance to the feathered race. It has a small bag or pouch on each side of the root or base of the bill, adapted, as it appears to me, to filter or strain its food; for in this bag I have always found gritty mud. Dr Knox is correct

as to the peculiar formation of the fore-legs; it can turn them almost any way. He is not, I think, equally accurate regarding the uses of the spur. It is my firm conviction that the animal has not the power of instilling poison by its spur; and I believe this appendage is used principally for securing the female in the season of love, though it may also be useful in enabling the animal to climb the steep banks of rivers. I have taken several large females, and I suppose old ones, with the hair worn off, and only the fine fur left on their rump; and although I have killed very large males, never found one in that state. The moment I saw the first old female thus denuded, it struck me that the denudation must arise from the action of the spur of the male in holding the female. If this be the principal use of the spur, and if it contained poison, I think it would be apt to wound the female at such times. I am so convinced that the spur is harmless, that I should not fear a scratch from one. However, I will try and set the matter at rest the first opportunity, by causing a male to scratch or wound a chicken. The female has no false belly or "sac," as Dr Knox seems to think it has, for I have taken about ten females, and never found any with that peculiar formation. I believe, however, the female gives suck; for, on skinning some females, I found the appearance of a gland, as if the seat of the "mammæ;" but not having any other object in view but the skin, and the appearance not being very striking, I did not examine it particularly. The ornithorynchi have holds or burrows in the banks, and among the rocks, and although they are most excellent divers, they do not live in the water, but on land.—*Letter from Thomas Axford, Esq., dated Thorpe, 30th June* 1828.

12. *Frozen Fish reanimated.*—I heard lately from an officer who had served in Canada, a fact which is well known in that country. My informant told me, that, in winter, the Canadian fishermen erect huts on the ice of the lakes and rivers, and cutting a hole in the ice, enclose it with a screen of straw, &c. to shelter themselves from the cold wind. Sitting inside the screen, they sink their hooks through the hole made in the ice. My informant said that he had frequently fished in this manner, and that amongst the other fish which he caught were perch in abundance. After hauling them up, he threw them aside on the ice, where they

were speedily frozen quite hard. He used then to take them home, and placing the perch in water near a fire, in a short time they began to exhibit symptoms of reanimation,—the fins first quivered, the gills opened, the fish gradually turned itself on its belly, moved at first slowly, about the basin, and at last completely revived, and swam briskly about. This experiment my friend Captain Sewell, of the 49th, often tried, and I place implicit reliance on his assertion.—*Lieut. Alexander.*

## *List of Patents granted in England from 27th November* 1828, *to* 19*th January* 1829.

**1828.**

Nov. 27. To W. GODFREY KNELLER of Great Pearl Street, Spittalfields, chemist, for "improvements in evaporating sugar, applicable also to other purposes."

29. To JOSEPH D'ARCY of Leicester Square, Esq. for "certain improvements in the construction of steam-engines, and the apparatus connected therewith."

To E. D. PHILP of Regent Street, chemist, for "an improved distilling and rectifying apparatus."

Dec. 4. To R. STEIN of Regent Street, for "improvements in distillation."

To W. BRUNTON of Leadenhall Street, for "an instrument to ascertain and register the quantity of specific gravity and temperature of certain fluids in transit, part of which invention is applicable to other purposes."

To P. DERBISHIRE of Ely Place, Holborn, for "a certain medicine or embrocation to prevent or alleviate sea-sickness, which may be usefully applied to other maladies."

To Z. RILEY of Union Street, Southwark, engineer, for "certain improved apparatus to be attached to carriages for safety in travelling."

To G. RENNOLDSON of South Shields, for his "improvements in rotatory steam-engines, &c."

6. To J. HAGUE of Cable Street, Wellclose Square, engineer, for "improvements in the method of expelling the molasses or syrup from sugar."

8. To J. DICKSON of Chester Street, Grosvenor Square, for "an improved projectile."

10. To J. BOASE of Albany Street, gentleman, and T. SMITH, mechanic, of Augustus Street, Regent's Park, for "improvements in machinery for scraping, sweeping, cleaning, and watering streets and roads."

To T. LAWES of the Strand, for his improvements in the manufacture of bobbin-net lace."

1828.

Dec. 10. To C. **Cummerow** of Lawrence, Pountney Lane, for "certain improvements, communicated from abroad, in propelling vessels."

To A. **Louis** of Dean Street, Birmingham, mechanic, for a "mechanical *volti subito* to assist the player of music quickly to turn the leaves of music books whilst playing."

To S. **Jones**, of the Strand, for "a new and improved method of producing instantaneous light."

To W. C. **Moore**, of New York, now residing at Hampstead, for "an improved method and machinery for manufacturing hats or caps."

15. To V. **Llanos**, of Hampstead, for "an improvement in bitts."

To J. **Forbes**, of Cheltenham, for "his method of consuming smoke."

To R. **Williams**, of Tabernacle Walk, Middlesex, engineer, for "improvements in the application of elastic and dense fluids to the propelling of machinery."

To **Anton Bernhard**, of Finsbury Circus, engineer, for improvements on wheels, or apparatus for propelling vessels," &c.

To J. D. **Whitehead**, of Oakview Mill, Saddleworth, Yorkshire, for "improvements in making cartridges for sporting and other purposes."

To J. **Morfitt**, of Cookridge, near Leeds, for "improvements in retorts used by bleachers and makers of oxymuriatic acid or oxymuriate of lime."

To J. **Slater**, of Birmingham, for "improvements in axletrees and the boxes for carriage wheels."

18. To J. **Levers**, of Nottingham, machinist, for "improvements in machinery for making lace or bobbin-net."

To W. **Stead**, of Gildersome, Yorkshire, mill-wright, and J. **Stead**, of Doncaster, for "a paddle-wheel on a new principle, for propelling steam-packets," &c.

To **Joseph Charlesworth**, and **Joshua Charlesworth**, and S. A. **Mellor**, of Holmfirth, Yorkshire, for improvements on gig-mills for the raising and finishing of woollen cloths," &c.

To J. **Simister**, of Birmingham, for "improvements in manufacturing a cloth or fabric, and the application thereof to the making of stays and other articles of dress."

To E. **Josephs**, of Haydon Square, Middlesex, for "improvements on the wheels, axle-trees, and other parts of carts," &c.

To F. H. N. **Drake**, of Colyton House, Devon, Esq. for "the invention of a peculiar till."

22. To W. **Parr**, of Union Place, City Road, Gent., and J. **Bluett**, of Blackwall, Middlesex, ship-joiner, and mast and block-maker, and pump-maker, for their method of producing a reciprocating action, by means of rotatory motion, to be applied to the working of all kinds of pumps and other machinery."

23. To G. **Rodgers**, cutler, J. C. **Hobson**, merchant, and J. **Brownill**, cutler, all of Sheffield, for "their improvements on table forks."

1829.

Jan. 7. To . H. Williams, of North Nibley, Gloucestershire, Esq., for his improvements in the paddles and machinery for propelling ships and other vessels on water.

To S. Gritton, of Pentonville, Middlesex, surgeon, and late of the Royal Navy, for "his improved method of constructing paddles to facilitate their motion through water."

To F. Neale, of Gloucester, barrister-at-law, for "his machinery for propelling vessels."

To W. Taft, of Birmingham, harness-maker, for "certain improvements in harness and saddlery."

To A. Robertson, of Liverpool, ship-carver, for "certain improvements in the construction of paddles for propelling ships, boats, or vessels on water."

14. To J. Deakin, and T. Deakin, of Sheffield, merchants and manufacturers of hardware, for "certain methods of making, from bones and hoofs of animals, various articles; namely, handles of knives, &c."

To J. Dickinson, of Nash Mill, in the parish of Abbots Langley, Hertfordshire, paper manufacturer, for his "improved method of manufacturing paper by machinery; and also a new method of cutting paper and other materials, into single sheets or pieces, by means of machinery."

To J. Smith, of Derby, engineer, for his "improved piece of machinery, which being combined with parts of the steam-engine, or other engines, such as pumps, fire-engines, water-wheels, air-pumps, condensers, and blowing engines, will effect an improvement in each of them respectively."

To C. Hewes, of Manchester, engineer, for "certain improvements in the form and construction of windmills, and their sails."

To J. Udney, of Arbour Terrace, Commercial Road, Middlesex, Esq. for certain improvements on the steam-engine."

To W. E. Cochrane, of Regent Street, Middlesex, for "an improvement on paddle-wheels, for propelling boats and other vessels."

19. To J. M. Ross, of No. 6. Symonds' Inn, Middlesex, ironmonger, for "an improved tap or cock for drawing off liquids."

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## *List of Patents granted in Scotland from* 6*th December* 1828 *to* 10*th March* 1829.

1828.

Dec. 6. To Thomas Tyndall of Birmingham, in the county of Warwick, gentleman, for an invention, in consequence of a communication made to him by a foreigner residing abroad, "for the improvement in the manufacture of buttons, and in the machinery or apparatus for manufacturing the same."

1829.

Dec. 12. To **William Strachan** of Avon Eitha, in the parish of Ruabon, in the county of Denbigh, manufacturer, for an invention of "an improvement in the making of alum."

24. To **Robert Stein** of Regent Street, Oxford Street, in the county of Middlesex, gentleman, for an invention of "certain improvements in distillation."

24. To **Anton Bernhard** of Finsbury Square, in the county of Middlesex, engineer, for an invention of "a method, or principle, or an apparatus, for raising water or other fluids."

Jan. 19. To **John Hawks** of Weymouth Street, Portland Place, in the county of Middlesex, iron manufacturer, for an invention of "an improvement in the construction of ships' cable and hawser chains."

Jan. 26. To **Valentine Llanos** of Hampstead, in the county of Middlesex, gentleman, for an invention communicated to him by a person residing abroad, of "an improvement or improvements on bits."

Feb. 26. To **Samuel Clegg** of Liverpool, in the county of Lancaster, engineer, for an invention of "certain improvements in the construction of steam-engines and steam generators or boilers."

March 5. To **Charles Harsleben** of New Ormond Street, in the county of Middlesex, Esq. for an invention "of certain improvements in machinery to be used in navigation, chiefly applicable to the propelling of ships and other floating bodies, and which improvements are also applicable to other purposes."

## LIST OF PLATES.

Plate I. Geometrical Projection for Edinburgh of the Solar Eclipse for 1833.

II. Mr Kemp's Galvanic Apparatus.

III. Mr Davidson's Syphon Lamp.

IV. Sections illustrative of Dr Turnbull Christie's Geology of the Southern Mahratta country.

V. Mr Watt's Magnetometer, and Mr Kemp's Blowpipe and Magnetical Apparatus.

### NOTICE TO CORRESPONDENTS.

The Editor regrets he cannot find room, until next Number, for several interesting communications sent to him. He requests Correspondents to make such arrangements as may insure their Communications reaching Edinburgh, at latest, by 20th February—20th May—20th September—and 20th November.

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